THE AEROPLANE

Incorporating
Aeronautical Engineering
Edited by - - THURSTAN JAMES

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Founder and First Editor
(1911-1939), C. G. GREY

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THE PROBLEM OF AIR TRAFFIC

DURING its first 40 years commercial aviation has been steadily putting up its operating heights. As the atmosphere in which man's aircraft fly surrounds a globe, every increase of height brings into use a volume bounded by segments of circles and not by parallel lines. In other words, the higher the world's airliners fly, there is increasingly more room for them. But although today we are entering an era where operating heights are around eight miles up air lanes are more crowded than ever and responsible authorities have become seriously concerned about effective air traffic control at all heights and not only during operation into and out of increasingly busy airports.

Last week no less an authority than the Director of Control and Navigation at M.T.C.A. gave some remarkable figures of air traffic density during a typical night last summer over the North Atlantic. Seventy-six crossings were being made. Of this total 88% Westbound and 62% Eastbound were within a band 210 nautical miles in width. If the aircraft concerned had carried proximity warning indicators with a 30-degree beam each side of the heading and a range of 100 miles with height information at all levels, alarm bells would have rung on 150 occasions.

Now commercial jetliners have entered the game, and not only over the North Atlantic. Small wonder that Sir William Hildred, Director-General of the International Air Transport Association, brought the subject of positive air traffic control to the fore in the course of his report to the 86 member airlines now represented at the Annual General Meeting of I.A.T.A. at Delhi. Sir William does not mince his words. On this particular subject what he has to say is undoubtedly timely though the observations will afford but small comfort to the harassed private owner.

In Sir William's opinion there is a need for air traffic services to provide positive control of airspace at all times, in all weathers and for all aircraft, whether military or civil. He hopes that governments will act as quickly as possible to accept the principle, to integrate and co-ordinate fully the civil and military traffic control systems which have hitherto been separate and to provide whatever additional services are needed.

A measure of the problem may be gathered from a disclosure in last week's report by H. A. Taylor on his flight across the North Atlantic by Comet. The aeroplane in which he was flying had climbed to 41,000 ft. but while on the way from Fort Chimo to overhead Montreal, the captain was informed by the appropriate air traffic control authority that altitudes in that sector between 35,000 and 45,000 ft. were blocked for the use of military traffic so the Comet had perforce to descend to a much less efficient cruising altitude.

This experience illumines another aspect of the effect of air traffic control on airline operations and one to which reference was made by Mr. W. C. Woodruff, Master of the Guild of Air Traffic Control Officers, at Southend last week. Speaking from the controller's side of the house, his plea was to the aircraft designers. They should, he felt, pay more attention to the known limits of air traffic control systems. For example, as things are today, the optimum cruising level could not be guaranteed for every jet flight.

This is well known already to traffic controllers and operations people alike. Flight plans are consistently filed for Comets making the North Atlantic crossing working on what is known as the cruise-climb, or drift-up, technique. In other words, as fuel is burnt the aircraft is allowed to climb slowly, for in this way the most economical cruising attitude is assumed by the aircraft. But such plans are seldom permissible from an air traffic control point of view.

The point ought to be made here that if aircraft designers were to wait for all other services to catch up, gaps between old and new designs of aircraft would be uncomfortably lengthy. We all know today that aeroplanes are much too fast and too large for the ground handling facilities available to handle passengers. Speakers at Southend made it equally clear that air traffic control systems need modernizing and extending.

Unfortunately, neither M.T.C.A. nor the Guild of Air Traffic Control Officers can directly bring about the integration of air traffic control areas. For obvious reasons these have been laid out to national boundaries. But with speeds approaching those of sound, airliners move so rapidly across national frontiers that control areas covering more than the territories of one state are now desirable. Thus there are political problems involved as well as technical ones.

The latter are still far from ideal solution, but there is increasingly a belief that certain British developments are available to make possible much better use of space over the North Atlantic. It is only a few weeks ago that a well-known test pilot, writing of navigation over that area, quoted an authoritative statement that air traffic control is working to one aircraft per 20,000 square miles. Accurate position-fixing devices should enable us to reduce this quite a lot.

MATTERS OF MOMENT

Anglo-Canadian Co-operation

A STRONG plea for the closest possible co-operation between the aeronautical interests in Great Britain and Canada was made in London last week by the Canadian High Commissioner, The Hon. G. A. Drew. He was speaking to a large and distinguished gathering at the annual luncheon of the Air League of the British Empire in the impressive splendour of the great Egyptian Hall of the Mansion House. Aviation was a field, he said, where the principle of interdependence could operate to the full advantage of the two countries as well as the whole Commonwealth. "Your great inventive skill, training in research and the accumulated industrial experience of more than 100 years," commented Mr. Drew, "combined with our own skills and vast resources, can place us at the forefront of air development if we work closely together with the rest of the Commonwealth."

Mr. Drew commented that during the past few days he had been visiting N.A.T.O. air bases in Europe where he had seen convincing evidence of the initiative, courage and skill of young men from every part of the Commonwealth. Their purpose he said, was peace and it was the devout prayer of every one of us that their purpose would be fulfilled. But, he went on, in carrying out this great task they were also providing an immense reserve of highly skilled personnel to operate the aircraft we would need in the years ahead. Mr. Drew added, "Please let us not become confused by new inventions which will have their vital and necessary place in all our plans for defence. Whatever may happen in any specialized field of military activity, the day of the manned aircraft has not gone."

He wished that everyone in the free world could see the "complex, efficient and fantastically costly" air defence organization which had been created by the co-operation of many nations. It was a most reassuring answer to those who might suggest that we had become soft and lacking in determination. But the knowledge that what we saw was in a large measure already obsolete should arouse a sense of compelling urgency to pool, not only the forces we maintained and the equipment we possessed, but also the experience with the least possible cost and the utmost efficiency.

Skill, productive capacity and resources must be employed with the greatest economy of time and effort if we were to build the strength to provide the strong shield which would restrain the action of those who threaten our freedom. In no case, said Mr. Drew, was this need for co-operation greater than between Britain and Canada.

No Decision on Differentials

FOUR WEEKS of discussion in the I.A.T.A. traffic conferences at Cannes ended last Saturday, October 25, without a decision on the question of differential fares for turbojets. Final action on the fares and rates after April 1, 1959, for the major World routes has, therefore, been postponed until early next year.

Nevertheless, the conferences have reached agreement on the many resolutions covering routes in Asia and elsewhere and, when the meetings reopen, the major part of the work will have been done on the detailed proposals for other major routes over which the turbojets will be flying in 1959. The prospects for an agreed system of turbojet/propeller differentials seem, however, to be poor—particularly following the views, stated some time ago by the United States C.A.B., to the effect that airlines should be able to operate turbojet aircraft at standard fares and that there should be no increase in present North Atlantic or trans-Pacific fares.

An immediate result of the failure to agree to a turbojet surcharge (demanded by Alitalia) has been, as recorded on page 663, the cancellation of Pan American's extension service at standard fares to Rome with the 707.

The adjournment was designed to give carriers more time to consider their positions on two principal issues arising from the introduction of turbojet aircraft. These issues were: the level of fares for turbojet services and proposals for low rates for certain commodities over the North Atlantic to fill the expanded cargo capacity which the coming of the turbojets was expected to generate. Several factors had made consideration of the question difficult: the lack of information on operating costs for turbojets; uncertainty on how much turbojet capacity would be offered on various routes during the year; the absence of any real knowledge of the extent to which public preference might move from one type of aircraft to another; and the fact that turbojet operators would themselves be flying propeller-driven aircraft simultaneously over the same routes.

Although a number of solutions were examined, certain companies were unable to accept any measures short of a surcharge on jets, and had made their acceptance of other fare and rate matters conditional on this point. After a period of turbojet operations, carriers should have a clearer idea of the results to be expected. They will also have an opportunity to discuss these results among themselves and it is expected that an acceptable solution will be found at the next conference.

The position over the North Atlantic cargo rates was similar. Some carriers felt that the time had come for drastic expansion of cargo traffic through the application of new low rates for specific commodities. Other carriers considered this move to be premature and uneconomic and one had insisted on a rate differential for cargo services in turbojet aircraft.

RECORD FLIGHT.—As recorded last week a Bomber Command Victor piloted by Wg. Cdr. D. Iveson recently flew from Farnborough to Malta in 2 hr. Above, Air Marshal C. E. Chilton, A.O.C., Malta, greeting the captain and his crew after the record flight; left, the Victor at R.A.F. Luqa.

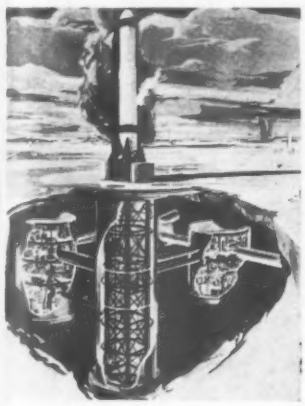
Private Flying Joint Committee

AT the time of going to press with "More Hope for Private Flying" last week (p. 603) we had not been able to establish contact with the Association of British Aero Clubs and Centres, news of whose excellent competition appeared on p. 607 in that same issue.

We have since had an opportunity to discuss the situation with A.B.A.C. and are indeed glad to learn that, though the representatives of A.B.A.C. did not attend the meeting arranged through the Royal Aero Club, representation has now been arranged. The A.B.A.C. has appointed Mr. G. H. M. Miles and Wg. Cdr. R. J. B. Pearse, O.B.E., A.F.C., to represent them on the new committee, formation of which is welcomed by the Association.

Blue Streak Launcher

IN the 1958 Defence White Paper it was said that the British IRBM would be launched from underground sites. This missile is the Blue Streak, under development by de Havilland Propellers, Ltd. Serious work on its launching system is obviously now beginning; de Havilland Propellers is at present advertising for a number of senior appointments in the research, investigation and design groups concerned with the Blue Streak underground launcher.



At present long-range missile sites are "soft," with all equipment on the surface, and thus highly vulnerable to attack by either conventional or nuclear weapons. The development of "hard" launching sites, which can withstand nuclear-weapon attacks, are planned for later U.S. missiles as well as for Blue Streak. The accompanying illustration is an artist's impression of an underground launching site for the Atlas or Titan ICBMs. The missile is prepared for launching underground, and is raised above ground level at only the last moment. Two interlocking concrete covers close the aperture through which the missile is raised from its underground storage pit.

In the illustration the cylinder on the left contains servicing and check-out facilities, while that on the right is used to store propellents. The launching would be controlled from a deeply buried control centre.

Friendship Fatigue Tests

MANY British aircraft companies and the Air Registration Board were represented at Luton Airport on October 21 when Mr. E. J. van Beek, Fokker chief structural engineer, lectured to the Luton Branch of the Royal Aeronautical Society. His subject was the fatigue testing of the Fokker Friendship.

After describing how the wing loads for the water-tank test of the Friendship fuselage had been derived from an analysis of typical flights over ranges of 70, 200 and 760 nautical miles, Mr. van Beek went on to describe the test set-up. The fuselage was immersed in a water tank almost up to the level of the wing, and repeatedly pressurized with water at 5 p.s.i. During each simulated flight, normal flight loads were applied to the wing and in addition 10½ loading cycles of ±6.45% of the wing ultimate bending movement were superimposed to represent gust, take-off and landing loads.

During this test there was a complete fatigue failure of the centre-wing lower skin close to the fuselage side, at the same place as the static test wing had failed at 114% of the ultimate load. An investigation showed that during the fatigue test a bending movement of ±9½% of the ultimate had in fact been applied. On the basis of this test 15,000 flights had been simulated and the results were accepted for the C.A.A. certification of the Friendship.

As a result of the failure the material for the Friendship centre wing had been changed from 75ST to 24ST and the lower skin was to be modified. The major reason for the change to less fatigue-prone material and to lower stress levels was that Fokker regarded the centre wing as a vital part of an aircraft; as a matter of commercial necessity it should never suffer serious fatigue difficulties.

Further fatigue tests with the Friendship had shown up places where fatigue cracks developed and had given the rate of crack propagation. At wing stringer joints this rate had been constant at about ¾ in. per thousand flying hours. Redux-bonded joints had shown up well during tests.

In testing the Friendship the material scatter factor had been found to be about 1.2. It was the uncertainties of operational service which demanded much higher scatter factors.

Mr. van Beek said that experience with the Friendship had convinced Fokker that neither the safe-life nor the fail-safe approaches offered a realistic solution to the fatigue problem; both tended to demand unnecessary weight penalties. With the Friendship the procedure in service would be inspection where tests had shown fatigue cracks were to be expected, followed by repair schemes whose effectiveness had been proven by tests. This approach had been accepted by both Dutch and U.S. airworthiness authorities.

UP AND ABOUT.—First free flight of the Short SC.1 was on October 25. After a vertical take-off, using the thrust of its four Rolls-Royce R.B.108 jet-lift engines, the SC.1 hovered and then moved slowly forward before landing vertically. A fifth R.B.108 engine at 30° to the horizontal in the tail gives thrust for forward flight.

Fatal Vulcan Accident in U.S.

A BOMBER COMMAND Vulcan from R.A.F. Waddington flying on a "Lone Ranger" training exercise to the United States crashed in a residential district of Detroit on October 24, killing all six of its crew. It was on a flight from Goose Bay, Labrador, to Lincoln A.F.B., in Nebraska.

Reports on the accident state that the captain sent out an emergency call reporting a complete electrical failure when the aircraft was at 35,000 ft. over Dresden, 60 miles north-east of Detroit. In this transmission he also asked for an emergency course to steer to Kellogg Field, near Michigan, but, before receiving instructions, called again for directions to any airport. This was the last message from the aircraft before the crash. Investigators of the accident stated that the Vulcan dived into the ground at an angle of 60 to 70°.

Avro Canada Hopes

CONFIDENCE that the Avro Aircraft Arrow and the Orenda Engines Iroquois will be ordered into production when Canada's Air Defence Programme is reviewed in March was expressed in Toronto on October 27 by Mr. Crawford Gordon, president of A. V. Roe Canada, at the company's A.G.M. He gave three main reasons. First, for the foreseeable future the manned interceptor would continue to be an essential part of the North American defence system; pilotless interceptors, such as Bomarc, complemented it but could not effectively replace it. Secondly, the Arrow was specifically designed to fit the R.C.A.F. requirement for a manned interceptor in the time period involved. Thirdly, a decision to produce the Arrow and Iroquois for R.C.A.F. squadron service would involve an actual cost from this point on of $3.5 million per aircraft, against $9 million per aircraft previously quoted, on the basis of 100 ordered.

Sir Roy Dobson, in his chairman's statement to Avro Canada shareholders, also expressed his confidence that it would eventually "find its rightful place in the sun." He forecast, too, that in all future aircraft there would be some element of vertical take-off. "Your companies," he said, "have not been lagging in this and other new branches of aeronautical science."

Firestreak Facts

PROGRESS with the Firestreak infra-red-homing air-to-air missile was described by Sir Ralph Sorley, deputy chairman and managing director of de Havilland Propellers, Ltd., at a Press conference on October 28. He said that the missile was already in use with the R.A.F. and Royal Navy; Firestreaks were being delivered to programme.

The range of Firestreak is between ¾ and 4 miles, depending on the closing speed of the fighter and its target, the altitude and the type of target from the infra-red viewpoint. The missile can be fired from dead astern to well on the beam of its target and will intercept an aircraft flying 10,000 ft. or more above the fighter from which it is launched. Its warhead is fired either by a contact or a proximity fuse. The current Firestreak will intercept supersonic as well as subsonic aircraft, but an advanced version is under development for the interception of aircraft in the Mach 2 class.

Naming the P.1B

AT a ceremony performed by the Chief of the Air Staff, Marshal of the R.A.F., Sir Dermot Boyle, at Farnborough last week, Britain's last manned fighter design, the English Electric P.1B, was formally named the Lightning. The C.A.S. broke a bottle of champagne (on a special chromium rig) against the nose of XA847, and at the same time unveiled the name flash which had been concealed by an R.A.F. ensign. The aircraft was subsequently demonstrated with characteristic verve by Wg. Cdr. R. P. Beamont, chief test pilot of the English Electric Co. Ltd.

The chairman of English Electric, Sir George Nelson, welcomed the C.A.S. and the many other important guests, who included members of the Air Council and senior representatives of the Ministries of Defence and Supply, the S.B.A.C., and firms responsible for developing the Lightning. Sir George also outlined the extensive background of aviation interest of the English Electric companies, and mentioned their wartime production of more than 3,000 Hampdens and Halifaxes.

In 1944, following Government pressure, the group established its own design department, while also beginning the construction of more than 1,400 Vampire jet fighters, and the result was the Canberra. More than 1,200 Canberras have been built, including nearly 400 under licence in the U.S., and others in Australia; the type is used in nine countries.

Then followed the P.1B, which within the past few weeks had been evaluated by a team of test pilots from the U.S.A.F. research centre at Edwards. Sir George said that he had reason to believe that they had returned glowing accounts of their flights. It was no secret that English Electric were already working on even more advanced projects.

Before naming the Lightning, Sir Dermot Boyle said that its previous code-names and numbers—F.23, P.1A and P.1B—had confused many people, and he was delighted that we at last had a name for the aircraft. He was confident that in the Lightning, the R.A.F. had a winner and went on to refer to the close co-operation between English Electric, Rolls-Royce, Ferranti and de Havilland Propellers that resulted in a weapons system which would be second to none in the World.

THE LAST-NAMED.—Sir George Nelson and Marshal of the R.A.F., Sir Dermot Boyle, with the Lightning after the naming ceremony at Farnborough.

It had been flown a great deal by R.A.F. pilots, and it was clear that Mr. F. W. Page and Wg. Cdr. Beamont had evolved an aircraft of outstanding merit. The Americans particularly extolled its climb, acceleration and inherent stability without recourse to autostabilization, and he was sure it would achieve a genuine M = 2 with a full war load. The formidable combination of AIRPASS, Firestreak, and the control and reporting organization with the Lightning made it a natural complement to the V-bomber force.

The Firestreak (which was mounted on the christened Lightning) was about to enter squadron service in the R.A.F. after very successful proving trials; was more advanced and powerful than the Sidewinder, and had more than come up to expectations for reliability and accuracy.

"LIGHTNING MY PILOT SITS."—After the naming ceremony, the Firestreak-carrying Lightning is towed out of the hangar for its demonstration flight by Wg. Cdr. Beamont at Farnborough.

News of Aircraft, Engines and Missiles

SWALLOW PROGRESS. — U.S. interest in the Vickers Swallow project (THE AEROPLANE, May 16) for an aircraft with variable-sweep wings has been officially confirmed. Questioned about this project in the House of Commons, the Minister of Supply's written answer was: "Since I made my statement to the House on May 22 last detailed discussions have been held with the American authorities and certain proposals are now being considered. The project is still in the research stages and further research work remains to be done before its potentialities can be fully assessed."

CIVIL SUPERSONICS?—It is reported that the English Electric Co. is working on a project which could be either a supersonic bomber or a commercial transport, production to be undertaken by another company.

TRANSATLANTIC CONWAYS.—Two Rolls-Royce Conway R.Co.10 bypass turbojets for the first Boeing 707-420 were flown from England to New York by Seaboard and Western Airlines on October 26, and thence by the Flying Tiger Line to Renton.

"AIRCRAFT AND AIR POWER"

UNDER this title a new book, designed for the young enthusiast interested in all aspects of present-day military flying, has been published by Temple Press Limited at 10s. 6d. It is written by F. G. Swanborough, of THE AEROPLANE, contains 108 pp., 5 in. by 8 in., and is well illustrated with line and half-tone pictures. It will be reviewed next week.

NEW PIPER.—The Piper Aircraft Corpn. is considering production of a new two-seat business and training aircraft to be known as the Papoose. It is to be a low-wing monoplane with side-by-side seating, nosewheel landing gear and a 90- or 100-h.p. engine. Subject to satisfactory market investigations the Papoose will sell at less than $5,000.

FIRE-POWER.—A Convair F-102 Delta Dagger all-weather interceptor fires a salvo of three Hughes Falcon AAMs. The missiles are stowed internally and lowered for firing when the armament-bay doors open. They are seen here just at the point of leaving the aircraft.

GERMAN CHOICE.—The Luftwaffe has at last finalized on the selection of an American design for its fighter interceptor units, but even now the choice has still to be decided between the Lockheed F-104 Starfighter and the Grumman F11F Super Tiger. Between six and 10 of the selected type will be bought from the American company, and a further 300 will be built under licence by the German industry, for initial delivery in 1961. In view of its proven performance and U.S.A.F. squadron service, the Starfighter is apparently more favourably regarded by the Germans for production.

MACH 2.0 MIRAGE.—On October 25 a Dassault Mirage 3, powered by a SNECMA Atar 9 turbojet, reached Mach 2.0 at Istres. It did not use its SEPR rocket to attain this speed.

SKYRAY RECORDS.—The F.A.I. has officially confirmed five rate-of-climb records set up by a Douglas F4D Skyray piloted by Maj. E. M. Lefaivre, U.S. Marine Corps, at Point Mugu, Calif., on May 22-23. The official times are 3,000 m., 44.392 sec.; 6,000 m., 66.095 sec.; 9,000 m., 90.025 sec.; 12,000 m., 111.224 sec.; 15,000 m., 156.233 sec.

JORDAN AIRLIFT.—By last week-end, more than half the 2,200 British parachute troops in Jordan had been evacuated to Cyprus in the initial stages of the withdrawal plan, which was due for completion by October 29. Eight Beverleys and six Hastings undertook the Amman-Nicosia shuttle service, via a specially approved corridor over Syria, after which Shackletons and Hastings were used to fly the troops back to the U.K.

ACROSS ANTARCTICA.—According to the Soviet Press, a twin-engined Russian aircraft recently flew non-stop across the South Pole from the shores of the Indian Ocean to the Ross Sea in less than 14 hr.

WESTLAND FINANCES.—A Group profit of £630,268 for the year ended June 30, 1958, has been announced by Westland Aircraft, Ltd.; this compares with £567,885 for last year. A 6% dividend has been recommended.

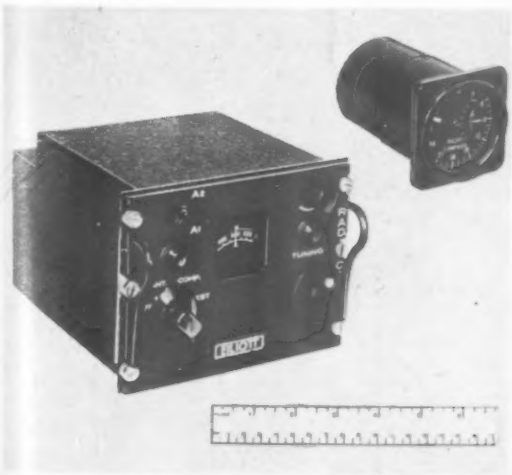
MORE NEWS ITEMS ARE ON PAGES 663-664.

Lightweight Elliott Radio Compass

A NEW lightweight radio compass is to be built under licence in Great Britain by the Radar Division of Elliott Brothers (London), Ltd., of Borehamwood, Herts. This radio compass, the Elliott type E-RCB-2, has been designed by Air-Equipment of Asnieres, France; it was demonstrated last week at Southend Airport by M. Arnaud of that company. The radio compass fitted in his Piper Tri-Pacer aircraft was the sixth to be built by the French company; the prototype was demonstrated in the same aircraft last year and described in THE AEROPLANE of September 13, 1957.

This radio compass consists of three units, the receiver, loop aerial, and bearing indicator. It weighs only 10½ lb. and has a frequency range of 200-800 Kc/s. Its cost will be £860 on a one-off basis, but it is hoped to lower this figure if the equipment goes into full-scale production

A convincing flight demonstration of the new equipment was given. While on the ground at Southend it picked up signals from Amsterdam. In flight it picked up a range of British beacons and its response speed was shown by a low-level pass over the low-powered Southend beacon. As soon as the aircraft crossed the beacon the indicator needle took less than 3 sec. to move through 180° on to the reciprocal reading.



Receiver and Bearing Indicator.

Air Transport

The 707 Goes into Service

WHATEVER one may think about the environmental, economic and traffic-supply problems facing the operators of the turbojet transport, there is no doubt that, if all goes well during the early months of operation, this type of vehicle is going to attract the passengers. And not only because of its much-publicized speed and comfort.

The Boeing 707, even in its initial -120 form, offers something new in air transport—an intangible impression of size and operating competence which may finally remove from the passenger's mind the idea that flying is a cosy, communal little transport adventure in which everyone is somehow sharing. Even the passenger who knows something of what is happening on the flight deck cannot, as one of 110-odd people in two big cabins, retain for long any sense of vicarious responsibility for the operating programme.

As the 707 pounds comfortably and unswervingly down the runway on take-off, accelerating to the pre-computed V_R and V2 for the weight and conditions, the know-all passenger feels just about as competent to judge the situation as someone on board the "Queen Elizabeth" while it is being juggled by tugs from its berth in Southampton.

Last Sunday Pan American started daily services between New York and Paris (not Rome) with its 707-121s. Five days before I had flown, with 110 or more journalists and others, on a final proving flight between London and New York via Keflavik, Iceland, in the second aircraft of this type ("Clipper Mayflower") to be delivered to this operator. The journey was made in an overall elapsed time of 9 hr. 27 min., including a 1 hr. 3 min. turn-round at Keflavik. The stage times were 2 hr. 45 min. and 5 hr. 39 min.—the latter over a track distance of some 2,330 n. miles.

The aircraft's weight out of London Airport, using the 9,312-ft. runway 28R for the 1,050-n. mile stage, was 211,000 lb., with 67,500 lb. of fuel. Rather less than 40 seconds was the time to unstick and the climb-away followed the agreed pattern with a full-power initial climb to 1,000 ft. at V2+10 knots. Thereafter, the normal climb to the selected cruising altitude (32,000 ft.) was completed in about 25 minutes.

The take-off from Keflavik's 10,015-ft. runway was made at maximum weight (247,000 lb.) and V2 was reached after about 8,000 ft. and 48 seconds. Since the climb-away was over the sea a normal technique could be used. The fuel weight for the New York stage was about 113,000 lb. (14,325 Imp. gallons). This fuel, over and above that estimated for the stage, provided reserves equivalent to a diversion to Boston, the chosen alternate, a margin of 20 min. for errors, or changes in the planned flight time, and a holding allowance of an hour or more at 25,000 ft. Because of unfavourable winds the flight was made at 24,000 ft.

The let-down at Keflavik had been normal, but for the descent into the New York traffic pattern the undercarriage was used as an air-brake—providing something rather remarkable in the way of deceleration and descent-rate at the cost of a moderately uncomfortable aerodynamic noise for the passengers. Reverse thrust was used for a relatively long period at Idlewild and the effect was impressive.

This particular 707-121 was laid out with 40 four-abreast de luxe seats forward and 66 six-abreast (plus three- and two-seat rows) economy class seats aft. Ahead of the first-class compartment there is a lounge on the port side and four of the seats in this section can, if necessary, be used by fare-paying passengers. The 120s on domestic or non-oceanic flights will have a normal flight-deck crew of two pilots and an engineer; the transatlantic 120s, like the 320s to come, carry, in addition, a navigator. Our crew was that for the transatlantic operation, though we had on board an additional navigator under training. There were five cabin-crew members.

Overall, the 707 is, at least for the passengers, the quietest aeroplane on the air routes today. For those in the last two or three rows in the rear of the fuselage there is some efflux noise and there is a faint compressor whistle to be heard in the forward areas of the front compartment; for the rest, what noise there is comes from aerodynamic sources. There is little vibration, even at take-off power, and the lily has been gilded by such methods as the rubber-mounting of the vinyl-coated metal panels used for the interior walls. The amateur photographer will dislike the small windows, but they are a practical feature for an aircraft in which there can be an almost unlimited number of seating arrangements. The positioning of the seats, in increments of an inch, can be matched by similar movement of the passenger service pods below the rack; these units, complete with automatic oxygen equipment, can be moved to any position to suit the seating plan. The spaciousness of the 707's cabin is accentuated by the use of large lighting panels in the roof.

Technically minded passengers in the rear compartment may have some surprises if they have not informed themselves in advance about the control system of the 707. The normal ailerons are, in fact, for low-speed use and operate only when the flaps are lowered; at all other times lateral control is obtained very effectively by using the high-speed ailerons, which are inboard of the outer flap sections, and the differentially operated spoilers ahead of the flaps.

Using the forward and rear doors together, there was little delay in embarking 110-odd passengers at London and Keflavik—but the same could not be said of the processing business on the way through London Airport Central. The situation was unique for this terminal and, with only one reception and baggage-weighing point and one channel in use, cannot be treated as typical. Nevertheless, the delays and discomforts were quite formidable and were an example of the kind of thing that is going to happen if airport authorities treat this big transport unit as just another aeroplane. Half-a-dozen Immigration and Customs channels were put into action at Idlewild's arrivals building and the passengers got through the formalities there just about as quickly as usual.

Not much has been said so far about a very different problem which is facing the first operators of the 707. There is trouble over the flight-deck crew complement and over the salaries to be paid to pilots of turbojet transports. So far as can be gathered, the pilots insist that the engineer should also be a pilot and are asking for a fairly big increase in pay. The result has been that all the 707 flying has been and is being done by supervisory flying staff, such as check captains, who are directly in the employment of Pan American and are not subject to the rulings of the Air Line Pilots Association. Unless the trouble is cleared during the next month or two a similar difficulty will apply to American Airlines, who took delivery of their first 707 from Boeing Field on Thursday of last week.—H.A.T.

PROVING FLIGHT.—The 707 (top) takes off on October 21 from London Airport's runway 28R and (left) is refuelled at Keflavik. Note the leading edge flaps in the top picture.

The G.A.T.C.O. Convention

A HIGH level of interest was maintained at the second Convention of the Guild of Air Traffic Control Officers, held at Southend-on-Sea on October 23 and 24. The five main papers covered various aspects of air-traffic control improvement from the viewpoint of the M.T.C.A., the operators, and the controllers themselves; a contribution from the C.A.A. was included to give some American views.

In his opening remarks, the Master of the Guild, Mr. W. C. Woodruff, made a plea for all possible assistance for A.T.C.O.s in the next five years, and stressed the importance of introducing new equipment as it became available rather than waiting for the ideal. So far as the new jets were concerned, the answers to some of the control problems were not known. Mr. Woodruff suggested that more attention should be paid by aircraft designers to the known limits of the A.T.C. system. For example, the optimum cruising level could not at present be guaranteed to every jet flight. Designers should seek to provide greater flexibility of cruising altitude, lower approach speeds and higher rates of climb and descent, in order to fit existing A.T.C. systems.

It was perhaps fortunate that no aircraft designers were present at the Convention, since this thought would no doubt have provoked lengthy arguments. Another contentious suggestion, made from the floor in the course of the Convention, was that air displays and fly-pasts were a considerable and perhaps unnecessary irritation to A.T.C.O.s and that civil controllers should have more say in restricting these to the minimum. Although strongly disputed by the Air Ministry representative present, this view was clearly shared and approved by most of the delegates.

The integration of military and civil air traffic so far as A.T.C. procedure is concerned, did not receive a great deal of attention during the Convention, despite—or possibly because of—the collision between an Italian jet fighter and a B.E.A. Viscount on the eve of the Convention itself. The two principal topics were the forthcoming modernization and automation of A.T.C. in this country, and the safe and speedy handling of jet aircraft. In both these subjects, there seemed to be a broad measure of agreement between the various interests represented, although in some respects, the collective Guild view diverged from that put forward by the M.T.C.A. Remembering that many air-traffic control officers are servants of the State, this is perhaps surprising, and suggests that liaison between the Ministry and G.A.T.C.O.—which the Master said was good—should be still better.

In addition to the five papers, the Convention programme included a Brains Trust, for which Air Commodore A. H. Wheeler took the chair. Panel members were Lt. Cmdr. M. J. Mogg, R.N., and Messrs. B. V. Coopman (Hawker, Dunsfold), L. Vass (R.A.E., Farnborough), and A. Field (M.T.C.A., Southern Centre) representing the controllers; and Messrs. Harris (Cossor), V. H. King (Decca Navigator), M. Settelen (Standard), Morgan (Marconi) and Dr. L. C. Payne (Decca Radar), representing the trade.

In the course of the proceedings, the Master announced the presentation to the Guild of a Trophy by Captain V. A. M. Hunt, C.B.E., F.R.Ae.S., Director of Control and Navigation, M.T.C.A. A silver salver known as the Hunt Trophy, this will be awarded annually by the Guild to the individual(s) making the greatest contribution to air-traffic control.

* * *

Brief summaries of three of the papers follow. In addition, Mr. W. Thomas Deason of the C.A.A. Paris office, described some of the ways in which the problems are being tackled in the U.S.A., and showed a film setting out the principles and advantages of VOR/DMET. *The fifth paper, contributed by Mr. H. E. Smith, B.O.A.C. navigation superintendent, was concerned with arguing the case for cruise-climb procedures for jet transports, and the need for improved long-range navigational facilities. We hope to deal with this paper at greater length in an early issue.*

"Some Trends in Air Traffic Control," by Captain V. A. M. Hunt, C.B.E., F.R.Ae.S., F.I.N., Director of Control and Navigation at the M.T.C.A.

Since it was impossible to cover the whole field of air traffic control, the author chose four particular issues, viz., self-help and visual flight rules; control at small non-State aerodromes; Atlantic control problems; and the allocation of air space.

Since many near-miss reports indicate that only one pilot saw the risk, it is clear that existing right of way rules need revision. The M.T.C.A. has suggested a new rule at the R.A.C. Division of ICAO now in session, the basis of which is that both aircraft should take avoiding action thus:

(a) by turning right when the other aircraft is on a relative bearing in the forward semi-circle between 45° stbd. and 135° port, and

(b) by turning left when the other aircraft is on a relative bearing in the other half circle.

Development of electronic aids to tell the pilot where and when to look would make a major contribution, as would an improvement in cockpit visibility. The suggested rule would be suitable for application by Radar Directors when necessary.

Turning to problems of control over the North Atlantic, the author showed slides to illustrate the eastbound and westbound traffic flow on a typical summer night, based on aircraft position reports to Shannon-Prestwick Control between 3° W and about 35° W. The plot showed that 88% of westbound flights, and 62% of the grand total of 76 crossings, were within 52° 50′ N and 56° 20′ N—a band 210 n. miles in width. If all these aircraft had carried proximity warning indicators with a 30° beam each side of the heading, and a range of 100 miles with height information over all levels, cockpit bells would have rung on 150 occasions on this night!

Capt. Hunt then went on to advocate a route system across the Atlantic, as previously suggested in the B.O.A.C. paper. The success of this idea depended on a decent navigational aid with plenty of intrinsic accuracy, and although ICAO has not made up its mind, Dectra is arousing much interest.

Another aspect of the Atlantic problem is the collection and presentation of information in a suitable form at the right times. The M.T.C.A. has asked Ferranti, Ltd., to develop a digital computor and magnetic memory to process flight plans, calculate elapsed times between position reports and print the flight progress strips.

Studies of the integration of jet and piston-engined aircraft—using radar simulation and a B.O.A.C. Comet—show that a smooth flow of traffic from one high-level and two low-level stacks can be achieved, and that the ability of the pilot to fly the approach pattern with precision without outside aid contributes markedly to the efficiency of the system. Although descent clearance will be given on route whenever possible, high-level stacks will be required for jet aircraft, and the datum points and approach paths must be in solid radar cover. These stacks could be over low-level ones or over the airport itself.

Modest rates of descent should be used—of the order of 1,500 ft./min. at 200 knots I.A.S. Descent to the runway threshold might take 16 minutes, and the flight path would be 54 miles long, including at least two right-angle turns. The final stage in line with the runway needs to be at least 10 miles.

Captain Hunt suggested two ways of improving the utilization of air space over the U.K.—better navigational aids and more adequate radar cover. Regarding the latter, the present plan is to provide three or four high-powered radars to cover all U.K. controlled air space and feeding information into appropriate A.T.C.C.s. The M.T.C.A. has issued a specification for long-range civil radar, and tender specifications will soon be prepared. The choice lies between 10 cm., 25 cm., and 50 cm. types, and the author indicated that although no final decision had been made, some 50-cm. equipment was likely to be used, mostly because of its weatherproof qualities.

Improved communications, better radar information and better navigational aids will require new centre organization. Centres will be divided into a Flight Plan Processing Section, Movement Planning Section, Flight Control Section (incorporating a Radar Safety Controller) and ultimately a Radar Filter Section.

The Ministry's aim is to introduce new equipment and procedures as they become available. The rough time scale to which the M.T.C.A. is working is as follows: Completion of Phase I modifications to A.T.C.C.s, spring 1959, followed by Phase II mods. a year later. New control towers at Ringway

and Prestwick, mid-1960. New A.T.C. centres in use in 1962. New forward radar stations (military) in use until mid-1959, followed by the new long-range radars coming into use 1959-61. Secondary radars, as found necessary by experience, 1961-63. Radar data extraction in 1961, followed by data transfer systems, 1961-62. Flight plan progress strip printers, already under development and evaluation. Storage and automatic processing of flight plans, by 1963.

"Air Traffic Control Displays," by Mr. D. D. Lipman, D.F.C., Head of the A.T.C. Experimental Unit, M.T.C.A.

This paper was complementary to that by Captain Hunt, and dealt with official thinking on the various types of equipment now in use, and expected to be used, in control towers and centres, including automatic and electronic processes.

The author divided his subject into two parts, concerned with State information and Traffic information. State information could be dealt with relatively simply, by using a quick-access filing system for semi-static information and reducing transient information to a minimum. For the latter, the humble scrap of paper might be sufficient, but Deccafax and Industrial T.V. might provide controllers with an "on-demand" system.

So far as the dynamic side of traffic information is concerned, the great need is for brighter radar pictures to permit daylight viewing and improved viewing conditions generally. Much could be achieved by a radar data processing system which would get rid of unwanted information on the radar controller's screen. He should see only those aircraft which he is controlling, and in respect of these, he wants to know five things: where, which way, what, present height and required height.

Position can be given by a bright spot, direction by the after glow or a vector arrow (the length of which can indicate speed), and identity and height information can be given by superimposed or separately displayed alpha-numeric codes.

Two forms of Flight Data Displays—both tabular—are required, for Radar Controllers and Procedural or Planning Controllers. Both must display abstracts of information regarding all traffic in the area. So far as displays for Radar Controllers are concerned, there are difficulties of space and lighting, and no really satisfactory alternative can at present be suggested for the current edge-lit Perspex sheets and chinagraph pencils.

For Procedural Controllers, printed flight progress strips can replace the present hand-written variety, but a satisfactory printer has still to be developed. It should be a strip-printer, perform "on-line" printing (that is, be actuated directly by a remote input) and, ideally, should have three sizes of type.

If an automatic data processing system is to be used, data displays must be capable of actuation by coded electrical impulses, limiting the methods of presentation to print, or alpha-numerical characters on a cathode-ray tube or an electro-mechanical indicator. Only the last-mentioned method seems capable of satisfying all the requirements.

Concerning the development of fully-automatic or semi-automatic systems, the author noted three criteria to be kept in mind regarding improvements to A.T.C. displays. First, the efficiency of a display system is limited by the efficiency of the overall system; secondly, the approach should be "what information *must* be had," so that emphasis is placed on really important data and "traditional" but possibly unimportant data are excluded; and thirdly, a decision has to be taken between "automation at all costs" and "let us see what a man can do."

Concerning this last point, the author said: "Under the first concept, the human operator is only used in a system where the limits of engineering alone prevent the use of a machine, whereas under the second, the system is designed to fit the capability of the human operator and to make the best use of his fundamental advantages over a machine: that is, his adaptability, his facility for both long- and short-term memory and his ability to exercise judgment.

"The latter approach is the one we have chosen since there is little to be gained in overall system efficiency from trying to obtain a complete mechanical or electronic solution to the problem, with the minimum of work for the controller, if this increases the maintenance, training, manpower and economic commitments to an impossible degree."

"The Human Element in Air Traffic Control Today and its Relationship to Future Developments"—a Guild paper read by Mr. L. S. Vass, member of the Technical Committee.

This paper set out the Guild's views on automation in the control tower and made it clear that the controllers themselves feel that much more use should be made of their "know-how" in the development of electronic aids. Indeed, the paper opened with a devastating attack on the development by the electronic industry of control aids which the A.T.C.O. did not want and the design of which paid scant heed to the operator's comfort.

The paper underlined the need for bright-tube radars for daylight viewing. All future plans for the presentation of Control information must presuppose that all functions can be performed in natural light. Concerning radars, the Guild gave a warning against the exclusion of 3- and 10-cm. types because of the precipitation clutter from which they suffered. There was a very real meteorological value attaching to these short-wavelength radars, which should not be completely sacrificed.

More use might well be made of radio-linking, from a radar head to a position some miles away. For instance, a military airfield with a comprehensive radar surveillance might be linked with a nearby civil airfield which could not afford its own radar system. This system would also help to overcome the shortcomings of telephonic liaison between Service and civil A.T.C. units.

Great efforts must be made to speed up and economize the use of available airspace to relieve the mental and physical strain at some high-density control centres and airfields where the controller—unable to stop his aircraft once it is airborne—must make continuous quick decisions. And no matter what functions become automatic, the A.T.C.O. must always remain in the background as the "fail-safe" unit.

Improvements are wanted in trans-oceanic navigational aids, which will bring in their train, especially in the U.K., benefits to navigation and control in terminal areas. By and large, the Guild believes that an area-coverage system is the only one suitable for the North Atlantic region.

Reductions are needed in the amount of written words, often meaningless and garbled, which clog the day-to-day working of the A.T.C. service. And finally, the Guild stressed again the importance of providing A.T.C.O.s with practical experience in the air, to keep them in the picture from the pilot's viewpoint.

IATA's Annual General Meeting

PRESIDENTS and senior executives of the 86 international airlines represented in IATA, gathered in New Delhi last week for the Association's 14th Annual General Meeting. The meeting followed the pattern set in previous years, in which the full assembly receives and approves reports from the various sections which, during the year, do the real work.

The 1958 report of the director general, Sir William P. Hildred, dealt at some length with the financial aspect of airline operation, both in the past and in the future. Despite the business recession, World airline traffic increased in 1957 by 13% and passenger kilometres flown by 16%. Total operating revenues increased to an estimated $4,100 m., but operating expenses also increased to an estimated $4,050 m., leaving an operating profit of 1.2%. This compared with a profit of 2.4% in 1956. It was still the consistent aim of IATA airlines to reduce fares, in order to tap new markets and, in this respect, economy-class on the Atlantic now carries 59.6% of the traffic, with 21% first class and only 19.4% tourist.

Present airline re-equipment programmes represent a fantastic capital investment, with 1,000 new aircraft on order worth $3,100 millions. They include 90% turbine-powered aircraft of which 460 are turbojet. It is certain that a considerable portion of the present fleets will be put out to pasture. Sir William noted that it was not possible to say with absolute assurance that the big jets will prove cheaper to operate; but they promised a lower cost per seat-mile which, with high rates of utilization, made them an attractive commercial proposition.

The coming of the turbojets leads to a need for air traffic-control services to provide positive control of airspace, at all times, in all weathers and for all aircraft, whether military or civil. Other matters dealt with by Sir William included the growth of air-cargo traffic, the need for airlines to advertise and the importance of hotel accommodation for tourists.

The Disaster in Italy

ON October 22, just after 13.00 hrs., a B.E.A. Viscount, flying from London Airport to Naples and Malta, crashed about 10 miles south-east of Anzio, Italy, after being in collision with an Italian Air Force F-86E Sabre at 23,500 ft. The 26 passengers and flight and cabin crew of five lost their lives. The pilot of the fighter, on a training flight from Pratica di Mare, survived, though injured.

A commission of inquiry was immediately set up by the Italian Ministry of Defence and an investigation team flew out from the U.K. on the same afternoon.

AFRICA BOUND.—The first Viscount 813 for South African Airways will be delivered shortly. Seven aircraft of this type are being built at the Bournemouth (Hurn) factory of Vickers-Armstrongs (Aircraft), Ltd.

B.O.A.C. Back to Normal

LESS than 24 hours after our previous issue closed for press and three days before publication of our note concerning the B.O.A.C. strike, the engineers concerned had voted for an immediate return to work. The decision took effect on the afternoon of Tuesday, October 21, and by next day all ground crews were working normally on servicing and routine maintenance. The first B.O.A.C. services out of London for eight days left London Airport during the afternoon of October 22 and included a Stratocruiser to Nigeria; Britannias to Bahrein and Jamaica and DC-7C to Montreal. But the resumption of the Comet weekly transatlantic service, scheduled for October 24, could not take place.

On the same day, the Court of Inquiry set up by the Minister of Labour to inquire into the causes and circumstances of the dispute at London Airport began its hearings. Its members are Professor D. T. Jack, professor of economics at Durham University (chairman); Mr. Norman Longley, past president of the National Federation of Building Trades Employers; and Mr. W. J. P. Webber, general secretary of the Transport Salaried Staffs Association. The setting up of this court appears at the moment to be the only useful result of the strike, and it is to be hoped that the report will contribute to an improvement in labour relations at London Airport.

Whilst it was never clear precisely what point was at issue between the strikers and the B.O.A.C. management—and the settlement of the strike involved no more than a mutual "no victimization" agreement and continuation of pay talks which had already been in progress—it is certain that all has been far from well among B.O.A.C. ground staff at London Airport for many years, and that blame for this situation attaches to both sides. In these circumstances, an independent inquiry can do nothing but good.

Cambrian to Continue

CAMBRIAN AIRWAYS, which has recently been placed in an extremely difficult position by the small amount of traffic offering on its domestic services in the U.K., has now made arrangements to continue operating one daily service. This is a return service joining Manchester, Cardiff, Bristol and the Channel Islands, and it will not operate on Sundays. The service to Manchester continues to offer connections with the B.E.A. services to Belfast and Glasgow.

The decision to continue with this service, beginning on October 27, reversed an early decision to suspend operations completely during the winter months. Earlier, Cambrian had announced that they would sell the three Herons operating international routes, and would concentrate on domestic services. In January, 1958, B.E.A. acquired a 33⅓% interest in Cambrian.

One result of the Cambrian contraction has been to deprive Bristol Airport of much of its traffic. In this connection, Jersey Airlines and Derby Aviation have both made applications to the A.T.A.C. for services between the Channel Islands and Manchester via Bristol and Cardiff. The Bristol Airport Committee has also approached K.L.M., Sabena and Air France in an effort to attract foreign operators to Bristol.

B.E.A. in August

TRAFFIC results for British European Airways during August showed a continuation of the summer trend—a small increase compared with the same period of 1957, but much less than budgeted. This meant that the revenue load factor showed a significant decrease for the 11th successive month.

For the summer as a whole, B.E.A. traffic was 2% up on last year, whereas capacity offered was up by some 10%. The financial results for the whole summer are not yet available, but enough is known to show that a very hard struggle indeed will be needed to show a profit in 1958-59. One satisfactory statistic was that first-class traffic between London and Paris improved by 70%; this is largely a result of the introduction of mixed-class service on all flights. In September, B.E.A. achieved a load factor of about 70% on the first-class accommodation offered on their international services.

	August 1958	August 1957	Variation
Capacity Ton Miles offered ..	21,243,000	18,998,000	+11.8%
Load Ton Miles sold	13,697,000	13,007,000	+ 5.3%
Revenue Load Factor	64.5%	68.5%	— 5.8%
Passengers carried	397,225	402,573	— 1.3%
Passenger Miles flown	134,975,000	129,975,000	+ 3.8%
Passenger Load Factor	70.4%	77.0%	— 8.6%
Freight Ton Miles	857,771	722,148	+18.8%
Mail Ton Miles	321,595	275,815	+16.6%
Aircraft Miles flown	4,315,000	4,034,000	+ 7.0%
Revenue Hours flown	23,660	23,441	+ 0.9%

AFRICAN ARRIVAL.—B.O.A.C.'s inaugural service with the Bristol Britannia 312 to East Africa was made on October 6. The aircraft is seen here at Entebbe Airport, Uganda, in front of the new control tower.

The Fighting Services

No. 10 Squadron's Standard

AT R.A.F. Cottesmore on October 21, No. 10 Squadron, the first Victor unit, received its Standard from H.R.H. The Princess Margaret, who flew to Cottesmore in a Heron C.3 of The Queen's Flight. She was met by the Station Commander, Gp. Capt. J. E. Johnson, D.S.O., D.F.C., and the A.O.C.-in-C., Bomber Command, Air Chief Marshal Sir Harry Broadhurst, K.C.B., K.B.E., D.S.O., D.F.C., A.F.C.

In her address to the Squadron Princess Margaret likened the V-Bomber force today to the "wooden walls" of old as the foremost weapon of defence in the nation's armoury; No. 10 plays an important part as the first Victor squadron, and it is singularly fitting that it should have received its Standard after having been re-formed in this important rôle, for No. 10 has a long history as a bomber unit, having been equipped with no fewer than five Handley Page types during its existence.

After the Presentation Parade, Her Royal Highness made a short tour of the station and inspected representative crews and aircraft of Bomber Command comprising, in addition to a Cottesmore Victor, a Valiant BK.1 from No. 49 Squadron, a Vulcan B.1 from No. 617 Squadron and a Canberra PR.7 from No. 58 Squadron. The concluding item of the day's proceedings was a fly-past by Vic-threes of each type of Bomber Command. This took place despite a very thick Midlands haze out of which appeared the Victors, Vulcans, Valiants and Canberras in succession.—J.D.R.R.

R.O.C. Recruiting

FOR the seventh successive quarter the Western Area, Royal Observer Corps, with Group Headquarters in Coventry, Shrewsbury, Caernarvon, Manchester, Lancaster, Carlisle and Belfast, leads the recruiting figures for the six areas of the Corps. The 1958 third quarter figures show that 612 volunteers —505 men and 107 women—joined the R.O.C., compared with 546 in the previous quarter. All areas except the Eastern and Scottish show a slight rise in recruiting, with the Western Area 41 volunteers up.

The R.O.C. is now 15,413 strong, a slight increase over three months ago, the individual Area strengths being: Southern, 3,399; Western, 3,218; Metropolitan, 2,728; Scottish, 2,201; Northern, 2,027; Eastern, 1,831.

Flying Safety Award

FOR his invention of a safety device known as a "jet clock," now extensively used in Flying Training Command, Flt. Sgt. F. G. Johns, an electrical fitter with No. 5 Flying Training School, R.A.F. Oakington, has won the L. G. Groves Memorial Prize for 1958. Awarded annually to the individual who has contributed the most to flying safety during the year, this is the first occasion on which the prize has been won by an N.C.O.

By incorporating both visible and audible warnings of the time when a pilot should receive a fuel-check call, the jet clock helps to eliminate the need for ATC controllers constantly to check the time that an aircraft has been airborne.

The Groves Meteorology prize for this year has gone to Dr. R. J. Murgatroyd, head of the Meteorological Research Flight at R.A.E. Farnborough. Controlling the flight for the past seven years, he has made a number of research contributions in the fields of cloud physics and of winds and temperatures at high altitudes. A third Groves prize for 1958 has gone to Flt. Lt. R. E. Parsons, A.F.C., of the Headquarters Coastal Command Communications Flight based at R.A.F. Bovingdon, following his two tours of special duty as Air Meteorological Observer Leader at Christmas Island in 1957 and 1958.

R.C.A.F. Command Changes

IN January of next year the R.C.A.F. Air Transport Command is to assume command of all regular force units now within Tactical Air Command. As a result of changing requirements, Tactical Air Command Headquarters in Edmonton will disband on January 1. This reorganization within the R.C.A.F., which is in effect a consolidation of the command structure, will result in considerable savings in personnel without any loss in operational effectiveness.

The history of the Tactical Air Command dates back to 1943, when the R.C.A.F. created the North-West Staging Route Headquarters at Edmonton to control all air operations over the northern Canadian area en route to Alaska. In 1945 several western Canadian formations were amalgamated and North-West Air Command came into being with a subordinate headquarters, No. 11 Tactical Air Group, at Winnipeg. When the R.C.A.F. created the Air Defence Command in 1951, this latter formation became the Tactical Air Command.

Australian Air Routes

TWO new strategic air routes to Malaya are planned by the R.A.A.F. as supply lines linking Australia with the British Commonwealth Strategic Reserve. One route passes through Dutch New Guinea, the Philippines and Borneo, and the other will run from Learmouth, in Western Australia, to Singapore.

Supply bases have already been established on the Dutch New Guinea route for the proposed movement of approximately 20 Sabres of No. 3 Squadron from R.A.A.F. Williamtown to Butterworth, in Malaya, on October 27. Aircraft of the second R.A.A.F. fighter squadron—No. 77—to be transferred to Malaya are to be moved early in the New Year (THE AEROPLANE, September 19, 1958). Referring to the ferry flights recently, the Air Officer in Charge of R.A.A.F. Home Command, Air Vice-Marshal Candy, said that they were the most complex operations undertaken since the Second World War. The Sabres fly over two stretches of water, each more than 1,000 miles long, and receive constant navigational checks from Canberra and Neptune aircraft flying ahead of them. The Sabre's maximum range in still air is approximately 1,200 miles.

The second air route, through Cocos Island, will be opened as soon as the air base now being constructed at Learmouth is completed.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

Group Captains: C. W. S. Jones to Headquarters, No. 40 Group, for administrative staff duties; R. F. Wynroe to the Central Medical Establishment as Principal Specialist in Radiology.

Wing Commanders: P. C. Cleaver, O.B.E., to the F.E.A.F. as Command Engineer Officer (with acting rank of Gp. Capt.); E. A. Darnell to R.A.F. Seletar, F.E.A.F., for administrative duties; K. Hellawell to the Central Fighter Establishment for directing staff duties; P. E. Mitchell to R.A.F. Swanton Morley for technical duties; W. C. H. Oatey, M.B.E., to R.A.F. Wellesbourne Mountford for technical duties; D. P. Singleton to No. 4 Mechanical Transport Squadron to command; B. B. Parker, W.R.A.F., to Air Ministry for duty in the Department of the Air Member for Personnel.

Squadron Leader T. de T. MacDonald to Headquarters, Bomber Command, for technical staff duties (with acting rank of Wg. Cdr.).

ROYAL VISIT.—After presenting No. 10 Sqn., the first Victor unit, with its Standard, Princess Margaret toured Cottesmore, escorted by the C.-in-C. Bomber Command, Air Marshal Sir Harry Broadhurst, and the A.O.C. No. 3 Group, Air Vice-Marshal K. B. B. Cross. Her Royal Highness is seen here talking with the crew of a Canberra, with a Vulcan in the background.

Dilemmas and Decisions

By Air Marshal Sir Robert Saundby

THE BELIEF is growing in the United States and, indeed, in other countries in the Free World, that since the War the U.S.S.R. has shown a clearer grasp of future military developments than any Western nation, and has successfully concentrated on the things that will decisively influence World affairs during the next few years.

In America, there is genuine anxiety lest, in spite of their immense expenditure on defence, they may find themselves for an uncomfortable long time unable to feel certain that they can retain the political initiative, or even prevent a full-scale nuclear Soviet aggression. They have realized, with a most unpleasant shock, that their technological lead—hitherto taken for granted—is seriously challenged, and may already have disappeared.

This is a new and profoundly disturbing development. When Maj. de Seversky in his book "Air Power: Key to Survival"* continually stressed American technological superiority, and wrote of their "stupendous technological heritage," even those who did not agree with his insistence on the vital need for overwhelming air power did not question this part of his thesis. They took it for granted that they could—and would—maintain their technological superiority, and they were concerned only to ensure that it should be directed into the most fruitful channels.

Recently two important books have been published in America which re-examine American defence policy from a new angle. In both these books there is an explicit assumption that the United States is about to lose, or has already lost, its technological lead to the Russians, and will for the next few years be in a difficult and indeed dangerous situation. The first book, "Victory without War, 1958-1961," published by the U.S. Naval Institute, Annapolis, was dealt with in an article in THE AEROPLANE on June 27 last.

Its main point was that, since the Russians would soon be capable of destroying in one surprise attack all the fixed U.S. strategic bomber and long-range rocket bases, it was imperative to transfer the largest possible proportion of their nuclear retaliatory power to mobile bases at sea—to aircraft carriers and especially to submarines.

The book was, to some extent, a piece of Naval special pleading, but it showed a very significant departure from the confident tone of most former books on defence policy.

There is now a tendency in the U.S. to take very seriously the possibility that the Soviet rulers, believing that they now have an opportunity which may perhaps never recur, will be tempted to stake everything on a surprise nuclear attack designed to knock out at one blow the retaliatory power of the West. Americans have not forgotten Pearl Harbour, and many leading exponents of American defence policy are seriously worried about this threat, though there is at present no great measure of agreement about the best way of meeting it.

All are, however, agreed on one thing. The United States must put its house in order and regain the technological lead at the earliest possible moment.

Lt.-Gen. James M. Gavin, of the U.S. Army, resigned a few months ago from his post as Assistant Chief of Staff for Plans and Operations. His reasons for doing so were not, as far as I can discover, ever made very clear—possibly in the interests of security—but it was understood at the time that he differed from the official policy of the Department of Defence on several important points. Gen. Gavin has now written a book, "War and Peace in the Space Age,"† which has not yet been published in this country, but a copy of which has fortunately come my way.

Gen. Gavin is a modern and thoughtful soldier, who has had a good deal of experience of airborne military operations. As commander of a paratroop regiment he was dropped in Sicily when we invaded that country in July, 1943. He was Senior Airborne Advisor to the Supreme Commander during the planning of "Overlord," and jumped over Normandy on D-Day as commander of a task force of three paratroop regiments. He also took part in the American drop at Nijmegen, in September, 1944, in the operation during which the British airborne forces, trapped at Arnhem, suffered so disastrously.

None of these operations was very successful and the Sicilian drop was a failure, but Gen. Gavin seems to have emerged from these experiences an enthusiastic believer in the value and importance of airborne forces. This basic conviction has coloured his thinking ever since, and seems to me to have caused some lack of balance in his military judgments.

Apart from the autobiographical section, Gen. Gavin's book is divided into two main parts, entitled "The Decade of Dilemma: 1945-1955," and "The Decade of Decision: 1955-1965." In the Decade of Dilemma the author sums up the lessons of World War II. He is not much impressed by the contribution made by air power, apart from Army support and the transport of airborne forces, and he quotes many airmen—including Gen. Douhet and Maj. Al Williams—who forecast that air bombardment would have rapid and decisive effects.

Photograph copyright "The Aeroplane"

AID FROM THE AIR.—In the book reviewed in this article the importance of air mobility is emphasized and the point is made that helicopters in sufficient quantity can provide the military with great advantages. Here two Whirlwinds of the Royal Navy demonstrate their usefulness as Service weight lifters.

He points out that this did not, in fact, happen; but he is less than fair to the Allied bombing campaign against Germany. He does not even mention the successful bombardment of Japan by the B-29s, which obviated the need for a sea-borne invasion.

He makes no allowance for the fact that World War II was the first war in which large-scale air bombardment was attempted. There was much to learn, and the weapons available were relatively weak and undeveloped. It is true that many people, and not all of them airmen, over-estimated the effects of air bombardment. Our Ministry of Economic Warfare and the American economic experts urged the importance of bombing the ball-bearing factory at Schweinfurt, which they regarded—quite wrongly, as it turned out—as vital to the German war effort.

Gen. Gavin contrasts this with the conclusion of the U.S. Strategic Bombing Survey that "there is no evidence that the attacks on the ball-bearing industry had any measurable effect on essential war production." This was no doubt true, and it was because the Germans had, unknown to us at the time, many other factories making ball-bearings, and could buy large quantities from Sweden. The selective bombing of what we used to call in Bomber Command "panacea targets" never had any worth-while results, mainly because our information regarding the vital nature of the target was usually incorrect.

Gen. Gavin notes the advent of the nuclear bomb, but does not appear to realize its full implications, as he says "the true lesson of the airplane in World War II is that, like other forms of mobility in the past, air mobility is most useful when employed to move man and his means of making war to the area of decision, and there to continue to work closely with him."

He does not approve of separate air forces, and deplores

* Published in the U.S., 1951.

† To be published in Great Britain early in 1959 by Hutchinson and Co. (Publishers), Ltd., of Great Portland Street, London, W.1. Provisional price 25s. net.

the fact that "one immediate consequence of our failure to understand the lessons of World War II was the separation of our air force and land force at the very time that they should have been becoming more closely associated." He believes that those who were dazzled by the immense possibilities of long-range aircraft armed with nuclear weapons have been responsible for a dangerous over-reliance on retaliatory power, and a consequent dangerous reduction in our conventional sea and land forces.

Gen. Gavin contends that the wholly irresponsible way in which the U.S. Army was demobilized after the War sapped its morale and reduced its efficiency, a state of affairs which persisted until the Korean crisis compelled the authorities to restore to the Army something of its former importance.

He concludes that not much attention, on the whole, was paid to the lessons of World War II. The outstanding lesson to those, like himself, "in the airborne business was the growing importance of air mobility." He believes that "finding the means, and developing the techniques, to achieve efficient air mobility was the big challenge in the wake of World War II," and that "airborne troops are our best national security and the World's most promising hope for international security."

Quick Transport Essential

I agree that, nowadays, we cannot have an effective strategic reserve in order to deal with small wars, unless it can be rapidly moved by air to any part of the World where it may be needed, and supplied by an airlift after its arrival. But I am also convinced that the first priority is to ensure against the outbreak of global war by means of a nuclear balance or, if you like, stalemate. Only when that has been achieved—and only for so long as it can be maintained—will the ring be held in which limited wars can take place. The problem, no doubt, is to spend the minimum necessary amount on the deterrent, so as to leave the maximum available to fight the limited wars which, if the deterrent holds, are the only kind of war we shall have to fight.

The General complains that the U.S. Army was starved of helicopters by the Air Force, which did not believe in them. A last-minute crash programme did enable the Army to save many lives in Korea, but he maintains that, had the Army possessed helicopters in sufficient numbers before that war broke out, it would have given it a great advantage in mobility over the North Korean and Chinese Communists.

I think that there is a good deal of truth in this but, as the author takes care to point out, the Air Force was working within the tight framework of a limited budget—a situation only too familiar to us in this country—and was convinced that it could afford little beyond the big bomber programme designed to prevent global war.

Gen. Gavin makes another point that is of interest to us, because our own White Paper on Defence, 1957 (Cmnd. 124), caused some confusion of thought on the subject. It is tempting to the Western industrialized countries to believe that they can use machines in war to save manpower; to suppose that if they have forces capable of preventing or, if need be, winning (in so far as that is possible) a full-scale war, they can use a part of those forces to win a small-scale war.

But, as Gen. Gavin says, "it makes little sense to assume that since one has the power to wage general war successfully, by using a little bit of that capability you have, *ipso facto*, a little war." The fact is that full-scale nuclear weapons are, in the American phrase, "packaged for strategic use" and they can be used only to a very limited extent, if at all, in small wars. At any rate, in Korea, Indo-China and Suez they were not used at all, and we chose to rely on land, sea and air forces using conventional weapons, and to observe such political restrictions as were judged to be necessary to prevent the war from spreading.

The problems of the Decade of Dilemma proved so intractable that few firm decisions were made, and even those were—according to Gen. Gavin—mainly erroneous. He attributes this, at least in part, to the establishment in 1947 of a Department of Defence, to which the three fighting Services were subordinated. Since, by United States law, military officers are forbidden to be Staff Officers in the Department of Defence, and may not hold executive or decision-making positions, the Secretary of Defence has to rely on civilian Assistant Secretaries, and an ever-increasing staff of civil servants.

The author cites many cases of delay, of incorrect decisions, and reversals of policy which have led to waste of time and money and, in his view, have been largely responsible for the loss of the American technological lead.

In the Decade of Decision, Gen. Gavin stresses the need for unity of purpose in the Free World, and makes the point that if we are to achieve this we must know clearly what our object is. We must know "what we are for." In his view, it is not enough to contain Communism, and any such purely defensive policy will be doomed to failure. We must recognize that freedom is indivisible; that a fence—even an Iron Curtain—cannot divide people into those who are free and those who are slaves; and that the World cannot continue half-slave and half-free.

And he insists that we must have a military establishment to support such a concept. He quotes the U.S. National Planning Association in support of the view that America could spend half as much again on defence without endangering its economy.

He goes on to consider the way in which a global war should be fought. On this study he gives new meanings to the words "strategy" and "tactics." Since he regards the whole World nowadays as no more than a tactical theatre, he elevates strategy in future to the status of a dimension—the fourth dimension of war, mainly concerned with technology, psychological warfare, and the exploitation of space. This is, I think, a pity, for it makes his reasoning harder to follow for those who tend to attribute their time-honoured meanings to those two words.

Gen. Gavin has a very high opinion of the possibilities of what he calls "the tactics of space combat" and he believes that "if this planet is to remain inhabited by man, a space programme must be developed under the United Nations." He gives no reasons for supposing that the United Nations would be any more successful in maintaining peace and security in Space than they have been on the surface of the Earth.

Gen. Gavin has no hesitation in regarding technology as an element of strategy. He says that if, in fact, "the strategy of the Soviets or the West were to be decisively successful without tactical battle, it would be in the field of technology, for technology contains all the elements short of war itself. Economics, natural resources, decision-making and lead time (elapsed time between design and quantity production), and superior weapons systems themselves are all part of technology. Each, if not properly understood and carefully planned, could directly contribute to strategic defeat." I think that most people would agree that the importance of superior technology is becoming more apparent every day.

He outlines his idea of a new organization for defence. First, he wants a military staff for the Secretary of Defence. This should be a fully integrated General Staff, as distinct from the staffs of the three Services. He believes that tactical nuclear weapons must become conventional in the armed forces of NATO and the U.S.S.R., for reasons of cost, effectiveness, and ease of handling, though they will not entirely replace high-explosive weapons.

Land Forces Decisive

He believes that major wars, even when both sides possess ICBMs, may be fought and decided by land forces, moved and supplied by air, using tactical nuclear weapons, tens of thousands of which will be needed. In starting wars the U.S.S.R. will always have the initiative, and the West must be prepared for anything they may launch, from a small limited conflict to an all-out global war. He admits that this will be very costly in money and man-power, but insists that there is no practical alternative.

With regard to long-range nuclear warfare, he is a strong advocate of defence in depth. "Anti missile" missiles only would be sited in forward areas. He would make all ICBMs fully mobile, and site them as far back as possible. Thus, in the last resort, he would defend Europe from Africa, South-East Asia from Australasia, and Canada and the United States from California. Anti-submarine missiles would be disposed around the coasts of the Free World.

It is now necessary, Gen. Gavin maintains, to recast our whole defence policy. He urges that our strategic planning should "reflect a full awareness of the current economic situation, the need for careful planning in the use of resources and, finally, the compelling importance of lead times to winning in a technological race." To what extent the existing set-up in the United States falls short of these requirements is difficult for us to judge.

This is a challenging, disturbing and puzzling book, written by a man who sincerely believes that the present defence organization in the United States leaves much to be desired. It is legitimate to hope that it will be read by those responsible for American defence policy, and that where it spotlights failures and weaknesses these will be remedied.

There are lessons in it for us, too, for it is even more important that this country should avoid mistakes in policy leading to waste of time and money. We have not at our command the vast wealth and resources of the United States, and we must ensure that the relatively small sum that we can allocate to our defence is well and wisely spent.

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Developing the Bloodhound

FIRST detailed account of the development of a British surface-to-air missile was read before the Guided Flight Section of the Royal Aeronautical Society on October 27. It was given by Mr. D. J. Farrar, chief designer (guided weapons) of Bristol Aircraft, Ltd., who described the evolution of the Bristol/Ferranti Bloodhound. The following description of work on Bloodhound from its inception is derived from Mr. Farrar's lengthy and detailed lecture, which will repay study by all who are interested in missile development. His talk was confined to the missile itself and did not discuss the variety of radar and other equipment which is associated with it in the overall weapon system.

Bloodhound has been produced as a collaborative effort by teams at the Bristol Aeroplane Co. and Ferranti, Ltd. From the beginning there has been a partnership, with neither team subordinate to the other. Bristol has worked on the airframe and propulsion with Ferranti concerned with guidance and control.

When the Bloodhound project began, surface-to-air missiles were already under development for the Army and the Royal Navy. A working party was set up to study the techniques necessary and the most suitable approach to the design of the missile which was to become Bloodhound. A basic requirement was high fire power and the use of radar equipment which was in existence or could be developed without major difficulties. Long range was necessary and thus the guidance system had to be suitable for much of the missile's flight to be at high altitude. For accuracy of interception over long range a homing system was considered essential.

These requirements were met by the use of semi-active homing. The target is illuminated by a ground radar while a receiver in the missile is locked on to the reflected signal from the target. In this way the missile is not constrained to follow a line-of-sight trajectory and the fire power of missile batteries is not limited by the number of fire-control radar sets available.

Propulsion Problems

Rockets, ramjets and turbojets were considered for propulsion. The ramjet was competitive with the rocket over short ranges, and had a greater development potential for a longer range missile because of its lower propellent consumption. The expendable turbojet engine was not competitive at any range. Ramjet propulsion was therefore chosen on the basis of missile performance, although some misgiving about powerplant development was felt because supersonic ramjet propulsion had not at that time been achieved in Britain.

No immediate attempt was made to design a weapon system; attention was focused on building up an engineering team and establishing guidance and propulsion techniques. This was done with two test vehicles, initiated by the Royal Aircraft Establishment and subsequently developed by Bristol and Ferranti. Firings of these test vehicles began less than six months after the basic decisions had been made on propulsion and guidance.

While basic techniques were being studied a second working party was considering the design of the missile. A range of configurations was studied and a further year passed before the final choice of design was made. Among the basic factors taken into account were radome aberration, manœuvrability, packaging and "stretch." These factors are described below in more detail.

If the weight and cost of a supersonic missile which flies over a reasonable range are to be economic, the missile must have a streamlined radome over its homing detector. This radome distorts the radiation reflected from the target, giving an erroneous line of sight, which rotates if the radome is rotated. This gives false steering signals whose effect on the missile can be very serious at high altitude.

Manœuvrability at high altitude is important. A balance must be struck between available manœuvre and the time required to develop the manœuvre.

It was desirable to divide the missile into different types of unit which are as independent as possible both physically and functionally. This was necessary both from the viewpoint of Service handling and so that development of each unit could proceed as fast as possible with the minimum of mutual interference.

The "stretch" requirement made it essential that the missile should be capable of operating over an increased range without appreciable re-design.

Three basic ramjet layouts were considered. An integrated ramjet and body with a nose intake was examined, but rejected because of the lack of space for guidance equipment and the effect of vibration. An integrated ramjet and body with side intakes was another possible solution, but this was turned down because there was no experience with side intakes in interceptor missiles. The final solution chosen for development was a multi-ramjet configuration. This required short ramjets with consequent intake and combustion problems; these difficulties were accepted. The designs considered are shown in illustrations on page 654.

Having decided on a multi-ramjet configuration, it was clear that more than one ramjet had to be mounted on the missile body. It remained to decide how many wings the missile should have and whether they should be fixed or moving. A series of paper designs was produced with combinations of fixed or moving wings, two or four ramjets, and cruciform or monoplane wings. A comparative study was made of their performance, particularly from the viewpoint of interception accuracy.

It was found that for a given missile weight the number of ramjets had little effect on performance. The manœuvrability of the cruciform fixed-wing and the monoplane moving-wing missiles was similar; a monoplane fixed-wing missile had the

This research vehicle, J.T.V.I., was used for early Bristol tests with ramjets. At one time it was known as the "only fully separating test vehicle," because of its tendency to fly to pieces, usually towards the end of the boost phase.

best manœuvrability of all. Response times in pitch were much shorter for the moving-wing designs. The fixed-wing design suffered from radome-aberration effects because of the changes in body attitude necessary in manœuvres.

The best overall compromise was considered to be the monoplane missile with a moving wing; this has moderate manœuvrability and quick response and does not suffer too much from the effects of radome aberration. The configuration was neatest with two ramjets and was chosen in this form for Bloodhound.

Use of a monoplane configuration for an interceptor missile is somewhat unorthodox, and the reasons for this choice are interesting; they are discussed below.

A cruciform-winged missile is controlled to fly a collision course by separate manœuvres in the pitch and yaw planes. Its miss distance can be increased by response lags and by cross couplings such as those between the pitch and yaw manœuvres; these affect the roll stabilization on which the system depends. On the other hand, a twist-and-steer monoplane missile rolls to align its wings in a direction at right angles to the one in which the manœuvre is required; the manœuvre is made by pitching. The only major cross couplings are gyroscopic forces.

This arrangement, incidentally, is the one favoured by Nature for all birds and most fish. It possesses the advantage of having a redundancy, in that failure of either pitch or roll control can still result in an interception course of a sort, while failure in one control plane of a cruciform missile is catastrophic.

Twist-and-Steer

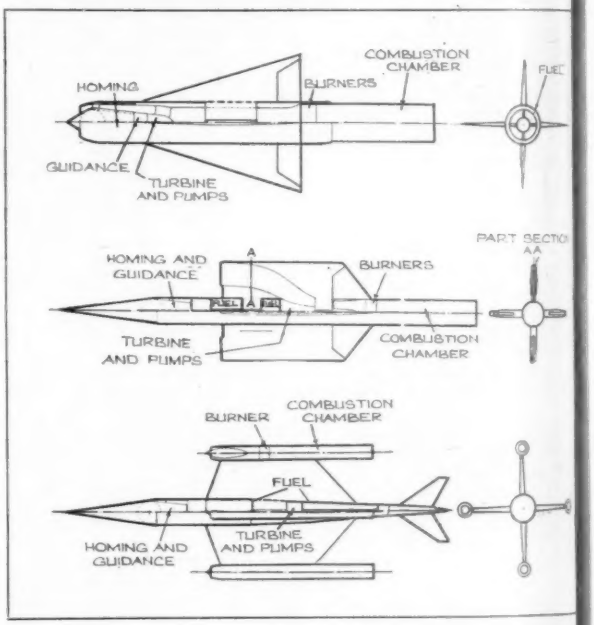
The response time-lag in roll of a twist-and-steer missile can be made much less than that in pitch. One might expect that a more accurate interception would therefore be possible and this is in fact so provided that resonance instability because of gyroscopic forces is avoided by suppressing body motion. This is done on a moving-wing missile such as Bloodhound. But if the roll rate has to be kept below the pitch or yaw frequency, the miss distance will not be better than that of the cruciform-wing system, except that cross couplings are reduced. This does not necessarily mean, however, that the kill probability is less.

In Bloodhound design it was necessary to reach a compromise between wing size, which decides manœuvrability at altitude, and homing-detector size, as an increase in size of the homing detector gives more accurate information on the position of the target and thus calls for less missile manœuvre. So far as possible the compromise was biased in favour of a large homing detector, as this also improves the range of target detection.

The missile configuration adopted as a result of these studies closely resembles the present Bloodhound except for a change in the tailplane and boost arrangement. Design and development of the missile followed, and, despite the late start, it appeared that the missile might reach service at the same time as earlier surface-to-air missiles then under development.

During the first three years of development, aerodynamic effort was devoted to evaluating parameters to decide, for example, how small a body incidence could be achieved during a pitch manœuvre. Moving tails were dropped early on, after a study of overall stability showed that body-to-wing angle ratios would be good enough without them.

Flight and wind-tunnel model tests showed that the early cruciform 45°-tail design was unstable in pitch at high wing



Three basic ramjet arrangements were assessed in the early stages of Bloodhound design. They are (top to bottom) an integrated ramjet and body with nose intake, an integrated ramjet and body with side intakes and a multi-ramjet layout.

angles. The vortex sheet caused considerable loss of efficiency and a large movement of wing-lift centre of pressure. It was realized that a more linear system could be obtained from in-line fins if the tail span was kept to about half the wing span. The 45° inclined tail also proved impracticable because the turbulent ramjet efflux had a destabilizing influence and the tail's proximity to the tailpipe caused some loss of efficiency.

Bloodhound wings were designed for pitch; they give more than adequate roll control and the missile could manœuvre considerably faster in roll if required. Rolling moment caused by combined pitch and yaw can easily be overcome.

The body shape was originally designed to give minimum drag for a given volume and body diameter. Absence of a body-mounted sustainer allowed a tapered rear-body to be designed; this has a favourable interference drag from the ramjet-lip shock-wave, particularly at low Mach numbers where it assists the thrust/drag margin at boost separation. The wing avoids to a large extent any interference with the ramjet intake, but at certain speeds the engine-lip shock strikes the wing. The difference in position of this shock-wave as wing incidence changes causes a lift which alters the wing centre of pressure; this

to some extent compensates for the losses as the wing root gap becomes greater with increasing incidence.

During a homing mission the missile sheds its boost rockets at around 2,000 ft., and drops very little in angle during the boost phase. Dispersion caused by wind is comparable with the random dispersion caused by variations in boost thrust. On a flight to medium or long range the missile then accelerates to its cruising speed within a few seconds.

As well as considering flutter and divergence, the effects of structural deformation on response to demands of the control system and the resulting manœuvres were studied. As a result of test-launching failures, wing torsional stiffness was increased. To obtain improved stability of the control system the body stiffness was increased and steps were taken to minimize variations in stiffness between individual missiles, and to minimize the non-linearity of body deformations with load.

All structural materials for Bloodhound are readily available and non-strategic. Because cost is vital the structure has been kept as simple as possible and the number of final-assembly operations reduced to the minimum. To do this magnesium-alloy castings have been used for many items. All bulkheads are one-piece castings of this type; they usually do several jobs. Mountings, brackets and pipes form part of the basic castings.

The remaining primary structure is mostly of conventional aluminium alloy, which is satisfactory for the kinetic-heating temperatures and flight times involved. Steel is used in a few special places.

To meet the definite stiffness required in the pitch plane, "backbone" members are used; they run along the top and bottom of the body with as few joints as possible. The joints which are necessary are made with tension bolts. This method gives reasonable agreement with stiffness predictions.

Wing, tailplane and boost fins are constructed from plywood matrices sandwiched between aluminium-alloy skins and mounted on spigots extending from the root. This combines ease of construction with low weight.

Some structure weight has been expended to achieve simplicity. The penalty in using thicker skins rather than stiffeners or more frames has been small and has allowed stiffness requirements to be met more easily. The thick-skin approach has also given more usable volume.

Ground-testing of components under the full flight-temperature environment has been found essential. All major components are now tested using infra-red lamps.

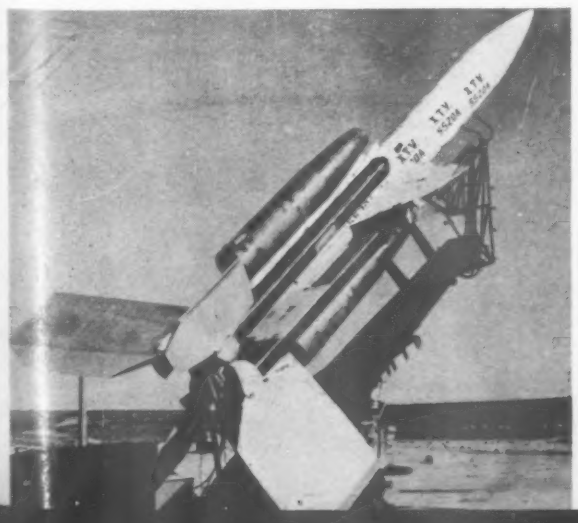
Control

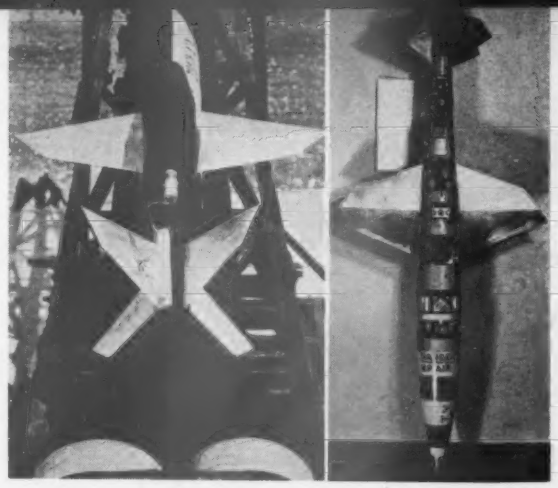
Pitch and roll manœuvres are obtained by moving the wings; they act symmetrically for pitch and differentially for roll, using appropriate feed-back controls. The pitch-error signal, in a suitable form, actuates the wings symmetrically. For rolling, the control input is a roll demand which is compared with the achieved roll; this operates the wing servo-mechanism to give a differential wing angle.

Response speed of the pitch loop is the time for the powerful wing servos to apply a wing angle; this is done very rapidly. Since the missile's centre of gravity and the wing centre of pressure are close together, little body motion is induced.

The moment of inertia in roll is much lower than the pitch and yaw moments of inertia, so that very high rates of roll and accelerations can be achieved. A high basic speed of response is achieved in practice by making the roll system much faster than the pitch system. By altering the gain of the roll loop with altitude the roll response of the missile can be maintained almost independent of altitude. Accuracy of roll control is essential to avoid manœuvre in the wrong direction.

There is no yaw control. With the unequal pitch and roll moments of inertia there is some cross-coupling into yaw. There are also aerodynamic cross-couplings from combined pitch and roll. But in spite of the large roll rates, with small pitch incidences and the small aerodynamic cross-coupling derivatives there is no significant aerodynamic cross-coupling problem. Yaw manœuvres of the missile have been small.



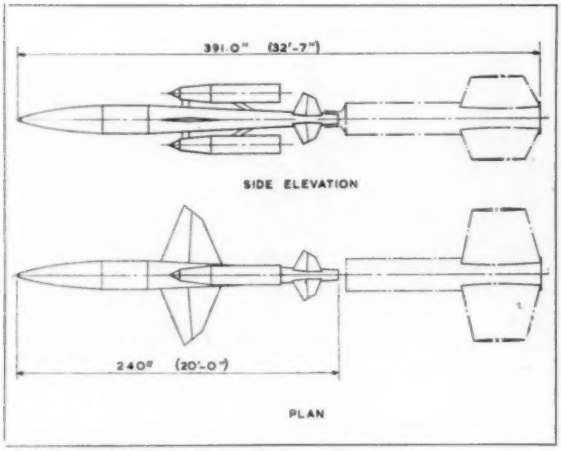


These test vehicles trace stages in Bloodhound development. X.T.V.1 (top left) was a ¼-scale model and X.T.V.2 (top right) a ¼-scale controlled model. The others, reading downwards, were X.T.V.3, a full-scale unpowered missile; X.T.V.4, a full-scale ramjet-propulsion test vehicle, which is seen in two views with different boost arrangements, and X.T.V.5, a complete experimental missile with homing head (below, left).

Bloodhound's control system is unstable in several ways, none of which matters in practice. Digital and analogue models of the missile and parts of it have been found extremely useful in understanding the system and evaluating flight trials.

Because of the need for long range it was decided that auxiliary power for the Bloodhound should be supplied by ram-air turbines fed from small air intakes and exhausting through the back of the missile. Initially there were three turbines, one each for hydraulic and electric power and fuel pumping. The number was soon reduced to two.

In designing Bloodhound the basic assumption was made that



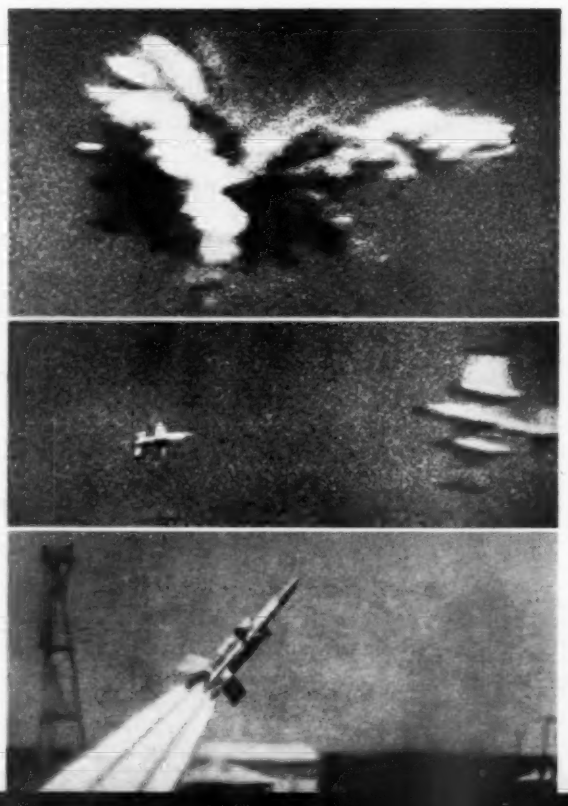
Most obvious differences between the original configuration chosen for Bloodhound (above) and the present-day missile (below, right) are the change to in-line tail fins and the current use of "wrap-round" rather than tandem boost rockets.

although few of its electronic valves would fail in flight, their characteristics might change because of vibration and acceleration. It was decided to use sub-miniature valves, since they had the smallest and strongest glass envelopes and structure, as well as smaller amplitude and higher frequency resonances which would make vibration mountings easier to design.

Electronic circuits were designed so that each valve had few functions to perform and so that the circuit would function even if valve parameters changed. No attempt was made to reduce the number of valves by using trick circuits where one valve had a multiple function. Block construction and potting of circuits were tried, but dropped in favour of a more open layout based on printed circuits.

A DC control system was used initially but, because drifts demanded correcting potentiometers, an AC system was finally adopted.

For the target detector a DC control system is used. Drift-free silicon-diode phase-sensitive rectifiers made the use of DC possible. Where experience has shown valves to be unsatisfactory, they have been replaced by transistors.



This interception sequence shows how an unarmed Bloodhound destroyed a target aircraft during development trials of the missile.

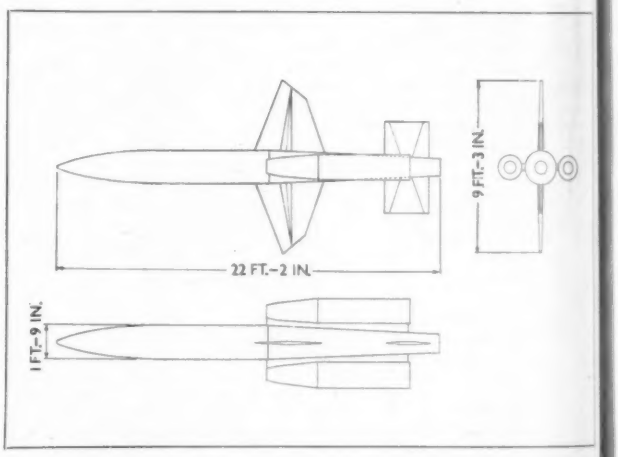
Power is supplied by an alternator driven by an oil motor. This avoids the use of stored energy, which might limit flight duration.

Flight Development

The "initial technique" test-vehicles, were the C.T.V.1, a coasting dart used by Ferranti for guidance, control and parachute-recovery development, and J.T.V.1, a ramjet test-vehicle with two six-inch ramjets on a slender body. Several different families of J.T.V.s were built and flown with a variety of different boost arrangements.

Five different types of test vehicles were used in Bloodhound development before the weapon stage was reached. They were X.T.V.1, a ¼-scale model; X.T.V.2, a ¼-scale controlled model; X.T.V.3, a full-scale unpowered missile; X.T.V.4, a full-scale ramjet propulsion test vehicle, and X.T.V.5, which was a complete experimental missile with a homing head and closely resembled the present Bloodhound.

For early propulsion work a joint Bristol-Boeing team designed a 16-in. ramjet, the B.B.1, in the U.S. This ramjet in various forms was tested on some 60 propulsion vehicles. The first weapon ramjet was designed in the light of this experience and tested on many vehicles; in due course almost every feature of it was redesigned. This led to the production Thor ramjet, which has proven combustion over a wide range of fuel/air ratios to match the various conditions met in homing flight up to high altitudes. Adequate thrust/drag margin is provided at the separation Mach number and the major part of the flight is controlled to the required Mach number.



Boost arrangements of various types were evaluated in the test programme. The tandem boost arrangement originally proposed was dropped because of the difficulty of obtaining adequate structural stiffness in the joint. The "wrap-round" boost arrangement now used was impossible initially because of the tail-fin arrangement chosen, but the final configuration became possible when in-line fins were adopted for the missile.

A fairly high rate of firing of experimental missiles has been maintained during the development period; this has been done to show up marginal failures as soon as possible, as well as to make possible an easier transition to production of the missile and to give statistical information on missile reliability.

Firing of the first X.T.V.4 at Aberporth from a zero-length launcher marked the beginning of the full-scale flight-test programme. When the tendency of these missiles to shed boost fins had been cured, ramjet propulsion flight soon achieved success. At this time the need for the modified tailplane and boost arrangement was appreciated; this was introduced into model and full-scale missiles within six months, permitting successful flights with X.T.V.5.

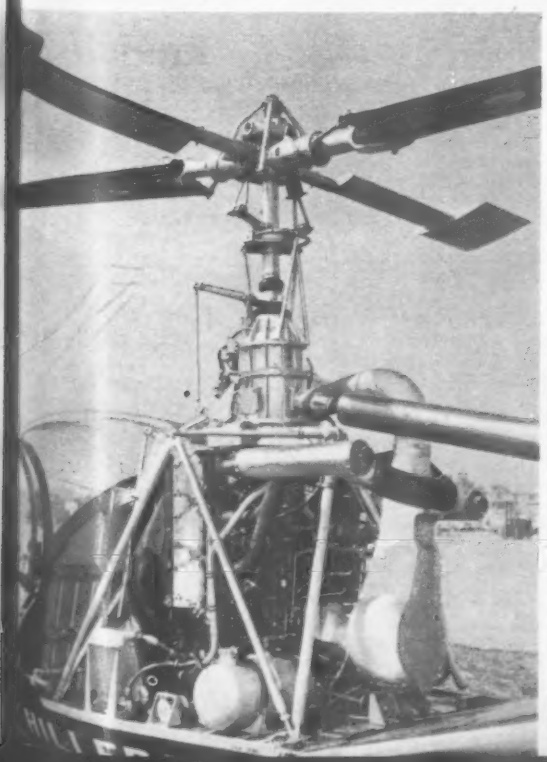
Many difficulties were met and overcome in the next year before successful flights were made with a complete homing head and with the missile under manœuvre control. At this stage it was decided not to begin guided flights until a homing head engineered to full weapon standard was available. Subsequent development has involved successful homing flights in a range of conditions with the weapon-standard airframe and homing head. These firings and Bloodhound's introduction into Service use began this year.

New World Photo-News

Pictures from Howard Levy

Above, the prototype Canadair 540 made its first flight at Santa Monica on October 11; it is a Convair 440 modified by the Pacific Airmotive Corpn. to have Napier Eland turboprops. The loaded weight is 53,200 lb. and 48 passengers can be carried. In the picture on the left are, standing, left to right, Mike Randrup, Napier test pilot, R. MacIntosh, maintenance supervisor, and Hal Herman, PacAero test pilot.

Below, Aeroproducts 13 ft. 6 in.-diameter propellers with 18-in.-wide blades, are used on the Convair YC-131C flying test bed, powered by Allison 501-D-26 turboprop engines.



Left, a close-up of the Lycoming installation in the Hiller 12E three-seat utility helicopter, a more powerful version of the H-23D being delivered to the U.S. Army.

Below, the 1959 version of the Bell 47J Ranger has a modified tail-rotor control to simplify maintenance. Larger drag-links are required for the metal blades of the main rotor.

British Light Aircraft Revived

IN the days before the War when the private-flying community in this country was a thriving one, and when there was quite a healthy light-aircraft industry, the Luton Aircraft Co. was well to the fore in producing small aeroplanes to meet the widespread demand that existed for them in those days. Pre-War readers of THE AEROPLANE will recall the Luton Buzzard, the Luton Minor and the Luton Major. All these were from the very productive drawing-board of Mr. C. H. Latimer-Needham, M.Sc.(Eng.), Dipl. Eng.(Lond.), F.R.Ae.S., A.F.I.A.S., who had left the R.A.F.—in which he held the position of Education Officer—to form the company of which he became managing director and chief designer. This was in 1935 and the company did well, but the outbreak of war in 1939 put paid to the light-aeroplane business and Mr. Latimer-Needham went to Boscombe Down as senior technical officer at the A. and A.E.E.

Although Luton Aircraft is no longer in existence and, in any case its factory, the Phœnix works at Gerrards Cross was burnt to the ground in 1943, there appears to have been some considerable post-War interest in its pre-War aircraft. This was highlighted recently when Mr. A. W. J. G. Ord-Hume—a keen private flyer and a staunch supporter of the ultra-light aircraft movement—built and flew his own Luton Minor. His efforts were rewarded a short while ago by the award of a plaque by the Experimental Aircraft Association of America.

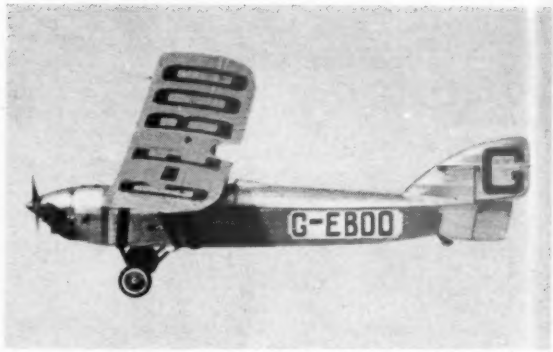
Because of this general interest and the useful potential

The 1936 Luton Minor is now being revived in post-War form for home construction by the amateur. Powered by an Aeronca J.A.P. it can cruise at about 75 m.p.h.

market that exists for home-built small aircraft, Phœnix Aircraft, Ltd., was brought into being in March, 1958, with Mr. Latimer-Needham and Mr. Ord-Hume as directors. The initial function of the new company—which would seem to be most appropriately named—was to take over and bring up to date the Luton Aircraft designs. So far, the drawings for the Minor have been completed, and those for the Major are nearly finished.

There are a good many people of the younger generation who believe that the aeronautical "do-it-yourself" movement is something new. The Luton Minor of 1936 was, in point of fact, expressly designed for ease of construction by amateur builders and as such was available in kits of parts. Just before the War a large number of Luton Minors were being built in all parts of the World, and several were known to have been completed and flown.

In their post-War form both the Minor and the Major will, in due course, be available in completed form. At present, however, they are available as sets of drawings and instructions for the home constructor—in fact, construction on a number of each type has already begun. The powerplant and other similar proprietary components—as well as those difficult to make, or hard to obtain—are obtainable from Phœnix Aircraft. And the company also intends to put on the market complete sets of parts which can be dispatched ready for assembly.



Photograph copyright "The Aeroplane"

Forerunner of the Luton Minor aircraft, the Halton Minus of 1928, satisfied all the requirements for a simple-to-fly ultra-light single-seater. At the 1928 Hendon Air Display it was unique in being the only club-built aircraft ever to take part in the fly-past of new types.

It has not yet been decided whether the Buzzard will be included in the company's range of products as the type is not considered suitable for private construction. Similarly, the Sports Major does not yet figure in their plans.

The Buzzard was the first of the Luton Aircraft powered aeroplanes and it flew for the first time in the autumn of 1935. It was a low-wing pusher monoplane powered by a 34-h.p. Anzani and was designed on sailplane lines with a 40-ft. span and an aspect ratio of nearly 11, to obtain the maximum aerodynamic efficiency. Other features included an all-moving tailplane, "trousered" landing wheels and split flaps. The overall layout was unusual in that the powerplant was mounted directly behind the open cockpit.

A later development of the Buzzard was a coupé version with a shorter-span (35.5-ft.) wing and a refined powerplant. This was still an Anzani, but was totally enclosed and equipped with dual ignition, an impulse starter, and improved valves and guides with duplex springs. This cleaner version of the aircraft had a top speed of 90 m.p.h. instead of the previous 80 m.p.h., and the complete aeroplane could be bought for the remarkable sum of £275. Its principal characteristics were:—

Span, 35 ft. 6 in.; length, 21 ft. 6 in.; wing area, 137 sq. ft.; empty weight, 380 lb.; loaded weight, 620 lb.; maximum speed, 90 m.p.h.; cruising speed, 80 m.p.h.; landing speed, 30 m.p.h.; range, 250 miles; initial climb, 400 ft./min.; take-off run, 100 yd.; and landing run, 50 yd.

* * *

The Luton Minor is a high-wing parasol monoplane of orthodox layout and is really a descendant of the Latimer-Needham Halton Minus of 1928 which, piloted by Flt. Lt. le Poer Trench, won the Sir Charles Wakefield Challenge Cup at Hamble in that year for the Halton (R.A.F.) Aero Club. In its post-War form the Minor has been improved in a number of respects. For example, a fixed vertical fin has been added; the tailwheel has been made fully castoring, and the undercarriage has been changed from one having outboard compression struts to one with a split axle and central supporting

Photograph copyright "The Aeroplane"

The Luton Buzzard was another successful pre-War ultra-light aeroplane, but is not considered suitable for private construction.

pylon. The 37-h.p. Aeronca J.A.P. twin-cylinder air-cooled engine has been selected as the standard powerplant, although it can be fitted with engines of up to 65 h.p.

The Minor should be particularly attractive to the private owner by reason of its transportability. The mainplanes and tailplane can be removed and attached to the side of the fuselage to enable the aircraft to be towed on its own wheels behind a car. As we have said, the Minor is primarily intended for home construction and Phœnix Aircraft reckon that the airframe, excluding engine, can be built for about £125. Suitable engines are available for about £100 complete with airscrew, and the total cost of the aircraft should not exceed £250.

As befits a structure intended for the amateur builder, the Minor's fuselage is a straightforward spruce-stiffened plywood box with a rear decking of fabric over stringers and formers. Similarly, the mainplane is a simple two-spar structure with girder-type ribs and is fabric covered with the exception of the leading edge and tips, which are ply covered. Two centre-section pylons act as the main wing attachment to the fuselage and two sets of parallel streamline-tube lift struts complete the bracing. The tail unit, too, is a very simple construction with fabric covering.

Principal features of the Minor with the Aeronca J.A.P. engine are:—

Span, 25 ft.; length, 20 ft. 9 in.; wing area, 125 sq. ft.; empty weight, 390 lb.; loaded weight, 627 lb.; fuel capacity, 6½ gal.; maximum speed, 85 m.p.h.; stalling speed, 28 m.p.h.; still-air range, 180 miles; initial rate of climb, 450 ft./min.; take-off run, 80 yd.; landing run, 40 yd.

* * *

In a larger category, the Luton Major is a two-seat cabin high-wing monoplane with the occupants in tandem. It has folding wings and is equipped with full dual control. The pre-War version was powered by a 62-h.p. Walter Mikron II and had a remarkably good performance. Indeed, during its initial flight trials in March, 1939, it was flown by Sqn. Ldr. E. L. Mole (as he was then), of the R.A.F. Staff College, who reported that the Major was exceptionally easy to fly, took off and landed remarkably slowly, was very comfortable, had unusually good visibility, had particularly good stability and a viceless stall.

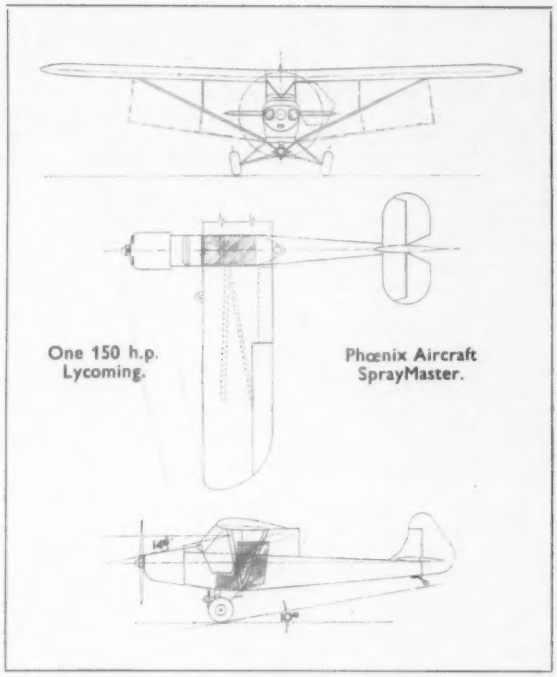
Pre-War photographs of the Luton Major which will be available from Phœnix Aircraft, Ltd., in kit-form for home building; sets of drawings of this aircraft for the amateur constructor are already available.

Photographs copyright "The Aeroplane"

Apart from some general modifications to bring the design up to present-day standards, the post-War Major is sensibly the same as the earlier version. The final choice of powerplant has, however, yet to be made, but there are a number of engines in the 60-h.p. category that would be suitable—the present Mikron, for example, or the Continental flat four.

Overall characteristics of the Major with the Mikron II are:—

Span, 35 ft. 2 in. (11 ft. 8 in. folded); length, 23 ft. 9 in.; wing area, 163 sq. ft.; empty weight, 600 lb.; useful load, 430 lb.; loaded weight, 1,030 lb.; maximum speed, 105 m.p.h.; cruising speed, 95 m.p.h.; landing speed, 35 m.p.h.; range, 300 miles; initial climb, 700 ft./min.; take-off run, 80 yd.; landing run, 50 yd.



In the new SprayMaster, which is based on the Luton Major, Phœnix Aircraft have set out to provide a small and cheap agricultural aircraft for crop spraying and dusting.

Although, as we have said, the Sports Major is not being considered at present by Phœnix Aircraft for resuscitation, it was an interesting development of the pre-War Major. Having the more powerful Gipsy Minor engine giving 95 h.p. and a reduced span (30 ft. 2 in.), it had a correspondingly "hotted-up" performance. Its gross weight was 1,220 lb. with a useful load of 520 lb.

A post-War development of the Major which does, however, promise to be a most useful addition to the range is the Phœnix PAL.7 SprayMaster—at present in the design stage. This, as its name implies, has been specifically designed for agricultural spraying and dusting to the requirements of Agricultural Aviation, Ltd., of Panshanger Aerodrome. A parasol wing arrangement has been chosen, as much for a good downward and all-round view as for the inherent stability characteristics provided by such a layout.

The SprayMaster is to be powered by a 150-h.p. Lycoming 0-320 and will have a wooden wing and a fabric-covered welded-steel tube fuselage. With a full fuel load of 30 Imp. gal., the aircraft will be capable of carrying a chemical payload of 550-600 lb.; the hopper has an actual capacity of 110 gal. of liquid or 6 cwt. of dust.

The principal dimensions, weights and performance figure for the SprayMaster are as follow:—

Span, 35 ft. 2 in.; length, 23 ft. 6 in.; wing area, 177.5 sq. ft.; empty weight, 1,200 lb.; fuel, 216 lb.; pilot, 170 lb.; chemical load, 600 lb.; loaded weight, 2,200 lb.; maximum speed, 130 m.p.h.; cruising speed on 75% power, 115 m.p.h.; stalling speed, 46 m.p.h.; range, 450 miles; initial rate of climb, 700 ft./min.; take-off run, 100 yd.; take-off over 50-ft. screen, 330 yd.

* * *

Although these notes have been necessarily brief, they will have sufficed to show that this new company—as the successor to a most lively pre-War team—are not wanting for ideas. By encouraging the home-construction of a British ultra-light aeroplane they might well inject a fresh measure of enthusiasm into the private-flying business in this country. And by producing a simple and cheap agricultural aeroplane they would seem to be filling a long-felt want.

At present the company's headquarters are at Cranleigh Common, in Surrey. But when the time comes to go into the production of kits of parts for the Minor and the Major—to say nothing of building the SprayMaster—no doubt some more spacious quarters will be needed. With their connections with Agricultural Aviation, these are likely to be in the vicinity of Panshanger.—F.T.M.

Symposium on Space Medicine

THE British Interplanetary Society's—and, it was claimed, the World's—first international Symposium on Space Medicine was held in London on October 16-17. The contributors included speakers from Holland, Sweden and the U.S.A.—the last-named being represented by a six-man team under the leadership of Cdr. G. W. Hoover, U.S.N., from the U.S. Office of Naval Research. Of the British papers, five came from the R.A.F. Institute of Aviation Medicine. Far from being flagrantly speculative, most of the communications read at this symposium illustrated clearly that space medicine, as an experimental and applied science, will be a gradual and cautious extension of aviation medicine.

On the first day of the symposium a miscellany of papers dealt with many aspects of physiological stress in space flight. As far as can be predicted, space medicine problems fall into two main divisions, dealing in the first place with the physiology and psychology of living in an isolated, sealed cabin outside the protection of the atmosphere and, secondly, with stresses produced by the dynamics of ballistic flight.

Problems of Weightlessness

Two papers dealt particularly with the problem of weightlessness in orbital flight and it was stimulating to hear more than the same old assurances—so often given—that as far as the body was concerned, everything would work all right under zero-*g*. The vital functions probably will, as DR. M. P. LANSBERG'S paper (from the Dutch National Aeromedical Centre, and read by proxy) reminded us; but, he pointed out, the patterns of nervous and muscular action in posture and task-performance may well be altered under weightlessness. Simple limb and body movements (such as reaching for a lever) would have to be "re-learned" if they were to be made with precision in free-fall. Some evidence of these effects already exists in subjective reports of zero-*g* manœuvres in aircraft. However, the conclusions drawn from these brief trials were criticized on the grounds that the disorientation reported by some subjects might have resulted from the angular accelerations occurring in short parabolic flights, as well as from the transition from positive-*g* to weightlessness.

SQN. LDR. T. C. WHITESIDE suggested that disorientation and motion sickness might be a major problem in space flight, a problem which had been previously mentioned in Dr. Lansberg's paper in connection with the rotation of satellites to produce artificial gravity. He also described, in his paper on vision and orientation at extreme altitudes, some present-day problems of vision in high-performance flight. Such phenomena as visual reaction-time, intense glare and the loss of the normal visual frame of reference, which already cause trouble in aviation, could be expected to be intensified in flight at orbital speeds and altitudes.

The afternoon session on October 16 was given over to psychological factors in space flight. The team from the U.S. Office of Naval Research gave a discursive presentation—largely devoid of detail—on the design of the "man-machine system" in conventional transport and in space flight. CDR. HOOVER showed a cartoon-film illustrating the conception and birth of the Army-Navy Instrumentation Programme. This is a bold approach to the whole problem of the exchange of input and output between man and the machines he controls and it proposes, among other things, that important information could more efficiently be presented to the man by means of stylized, spatially related symbols than by conventional displays.

The theme of human performance in control and the factors which—by disturbing the man or the machine—affect it, was taken up by DR. K. F. JACKSON (R.A.F. Institute of Aviation Medicine). It was refreshing to hear actual experimental findings presented. He was able to show, from in-flight measurements of error variation in navigation and from laboratory studies using a multiple tracking task, how various factors (such as the overall and divided lengths of time on a task and the complexity of a task) were able to influence the man's efficiency in control and elicit adaptations of his working technique. Applications to the space flight situation were cautiously indicated.

In the last paper of the psychological session, some interesting effects upon the mind of reduced bodily sensation and isolation were described by MR. C. CUNNINGHAM (Air Ministry). Feelings of mental discomfort and hallucinations can be aroused by suppression of sensory input under laboratory conditions, and similar, although generally mild, symptoms have occasionally been noticed during high-altitude flight when nothing of interest is happening. It might be predicted that the conditions of isolation would be more intense in silent, weightless space flight, and that severe sensory deprivation lasting days or weeks would have serious consequences. But, Mr. Cunningham pointed out, there were large variations in individual tolerance and adaptability

Oxygen and food requirements on short space voyages (say, six days) were discussed by DR. G. PUGH (Medical Research Council) who described, in the light of his research on altitude acclimatization, some intriguing possibilities of economy of payload. A low-pressure cabin atmosphere is often suggested in order to save structural weight, but a normal oxygen tension is usually assumed to be necessary. Several weeks' acclimatization at altitude, we gathered, might enable the man to perform normally in a space-ship at a cabin-altitude of about 18,000 ft., with a normal percentage of oxygen in the air. We were warned, however, of the increased risk of carbon monoxide contamination of the atmosphere. In addition, by selecting small people and putting them on a reduced (1,000-calorie) diet, it was suggested, the requirements of oxygen supply and carbon dioxide clearance could be still further reduced. The compromise between health and economy which is eventually achieved remains to be seen.

More remote possibilities of economy in victualling were suggested in an absorbing paper read by DR. A. S. PARKES (National Institute for Medical Research) who, in conjunction with DR. AUDREY SMITH, presented some details of their investigations into the resistance of animals to freezing and drying. Despite the sober warning of the authors that the space transport of frozen (and therefore metabolically inert) human beings was a far-off ideal, one felt that here was a good way to spend the long years of interstellar voyages.

In-space feeding for the conscious pilot was reviewed by MR. S. W. F. HANSON (Ministry of Agriculture, Fisheries and Food) who, in a critical presentation, described feeding needs and methods best suited to short, medium and long voyages. He was critical (as were several others) of the feasibility of developing—for the long interplanetary journey—self-regenerating plant cultures which would provide food and oxygen in return for human waste.

That algal cultures can be established on an experimental scale had been shown by DR. H. E. SHEETS (General Dynamics Corporation) during the U.S.O.N.R. presentation, but objections were raised on several grounds. It was suggested in discussion that there were serious risks of contamination.

The Need for Thermal Protection

Physical stresses anticipated in space flight were covered by several papers. FLT. LT. J. BILLINGHAM, R.A.F., in two contributions, described the problems of insulating the man against heat stress as it might occur in various spaceflight situations—which, on the basis of well-defined assumptions, he had analysed in realistic detail. The merits of different insulating materials and heat-exchange devices were compared and it was shown that in some situations, highly efficient thermal protection would be needed.

During re-entry, serious heat stress might again occur (in addition to the physical load of deceleration and vibration which, it had been suggested by FLT. LT. J. GUIGNARD, R.A.F., may also add to the astronaut's discomfort).

Although prolonged positive acceleration is not usually envisaged in space flight manœuvres, some centrifuge studies of positive-*g* on dogs and their respiratory function were presented by DR. H. BJURSTEDT (Laboratory of Aviation and Naval Medicine, Stockholm). He showed that, under prolonged positive acceleration, there was a deficiency of oxygenation of the blood in the lungs—"accelerative anoxia"—which, he suggested, might be a contributory factor in lowering performance.

In another paper from Sweden, DR. C.-J. CLEMEDSON (Research Institute of National Defence, Stockholm) emphasized the dangers of meteoric penetration of a space vehicle, in the light of his well-known work on blast injury and explosive decompression.

The Symposium ended on an alarming note, when DR. A. E. SLATER (B.I.S.) reviewed the discoveries of intense radiation just above the atmosphere in the middle geomagnetic latitudes which had been made by the Explorer satellites. Statements that a lifetime's permissible radiation dose might be exceeded in a few hours had tended to dampen astronautical ardour. But, Dr. Slater suggested, there was hope of solution: the available evidence was tending to confirm the conclusions of Professor Singer that the radiation belt was limited in both latitude and distance from the Earth. Its harmful effects might be avoided by navigation, rapid penetration or even, perhaps, electromagnetic deflection of the lethal protons of which it is believed to be composed.—J.G.

Thrust Reversal for the Comets*

VISITORS to Farnborough in September were doubtless impressed by the demonstration of thrust reversal given by the D.H. Comet 3B, which was brought smoothly to rest in 800 yd. after touchdown. This is the development aircraft for the Comet 4B fitted with two Rolls-Royce thrust-reverser units on the outboard Avon Mark 524 turbojets.

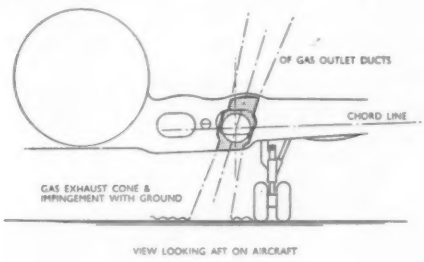
On wet and icy runways wheel brakes can be almost useless. With piston-engine or turbroprop aircraft an answer independent of the runway lies in the reversible propeller. With a pure jet there are the alternatives of a tail parachute or—a more practical and elegant solution—thrust reversal.

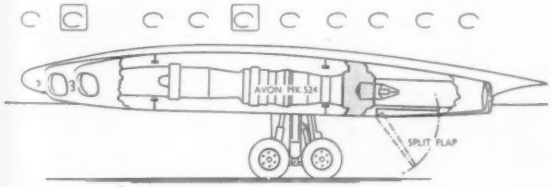
The extent to which reversers are necessary depends, for any given runway conditions, upon the landing speed of an aircraft, the length of its landing run, and its weight.

The Comet 4 does not in fact require thrust reversal on many runways. On routes where "difficult" runways are met it will, however, be desirable to fit thrust reversal with the object of enhancing payload, at the same time improving the Comet's high standard of safety. Reduced wear on tyres and brakes may well provide worth-while by-products.

Early Testing and Development

Interest in reversers for the Comets stems from early 1954, when it was decided to fit a trial installation in the port outer engine position of the prototype Comet 2.





REVERSER SEQUENCE.—These diagrams show the installation on the outboard engines of the Rolls-Royce thrust-reverser units of the Comet 4.

The de Havilland Aircraft Co. accordingly designed and built a "fixed" reverser—a unit which could be used only in reverse. This was run by Rolls-Royce on the test beds at Derby, using an Avon R.A.9 power plant. Failures and distortions due to heat occurred in these early tests and the lessons learnt were embodied in a second "fixed" reverser which satisfactorily completed bench, ground and taxi tests.

The drill was to start the reverse engine and run it at idle r.p.m. The aircraft then took off on three engines with the reverse engine idling, completing a normal circuit and approach on three engines.

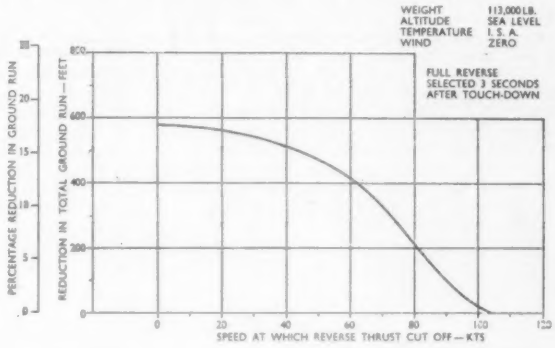
On touchdown the reverse engine was opened up to full power with encouraging results. There was no tyre scorching, and ingestion did not appear an insuperable problem—naturally it was most important that the jet stream discharged forward beneath the wing should not re-enter the air intake and cause engine overheating and surge.

EXTERNAL EVIDENCE.—Upper exit for thrust-reversal efflux on the Comet 4 is the grille over the outboard engine bay. Fairing doors proved to be unnecessary.

Rolls-Royce in the meantime had been designing a reverser using the same principle, but this unit was to be controllable so as to give normal forward or reverse thrust. This became the basic design for the thrust reversal unit now offered for use in the Comet 4s.

In all, Rolls-Royce and de Havillands have accumulated the following experience with reversers, up to September, 1958:—

	Comet type	*Comet type suitable for Hunter*
Total hours of all running on test beds ..	1,056	457
Total hours in reverse on test beds ..	64	80
Total number of reversals on test beds ..	2,284	1,765
Total hours flying	94 (*in Comet 3B*)	60 (*in Hunter*)
Total number of landings	90	280
Total number of taxi-ing runs	6	28


WEIGHT 113,000 LB.
ALTITUDE SEA LEVEL
TEMPERATURE I.S.A.
WIND ZERO
FULL REVERSE SELECTED 3 SECONDS AFTER TOUCH-DOWN
PERCENTAGE REDUCTION IN GROUND RUN
REDUCTION IN TOTAL GROUND RUN—FEET
SPEED AT WHICH REVERSE THRUST CUT OFF—KTS

BRAKE BENEFITS.—This graph shows the reduction in ground run obtained with the Comet 4 by use of thrust-reverser units on the two outboard Avon engines.

Installation in the Comet 4

It was decided at the outset to fit thrust-reverser units only to the Comet's outboard engines, because, on balance, four reversers were not worth while having regard to complexity, weight and expense. In addition, and of great importance, the discharge above the wing from the inner thrust reversers would have come too close to the fuselage.

The reverser unit is fitted immediately aft of the rear spar from which it is supported by struts; the jet is discharged above and below the wing ahead of the aircraft at an angle of 45° to the horizontal, the units being canted at 20° from the vertical to ensure adequate tyre and landing-gear clearance underneath, and fuselage clearance on top of the wing.

The original installation had outlet doors which could be closed when the thrust reversers were not in use, obviating the drag penalty suggested by wind-tunnel tests.

Subsequent flight measurements showed that in fact the removal of the doors caused no measurable increase in drag,

* This feature is based on an article by Mr. F. I. Marking, A.F.R.Ae.S., deputy chief engine installation designer, The de Havilland Aircraft Co., Ltd.

and that their presence represented an aerodynamic luxury. Moreover their deletion made it possible to save much of the complication and weight inherent in the control arrangements; these had been designed to ensure that thrust reversal could not be operated with the doors closed.

Ingestion

Temperatures were measured at the face of the air intake and, in addition, hydraulic fluid was injected into the jet efflux immediately upstream of the reverser outlets. This produced the smoke necessary to enable the flow pattern to be seen, but the method proved difficult to use because, when enough smoke was obtained to see the flow pattern, it was usually too much to see it clearly.

The next interesting experiment was the tossing of ice cubes of about 1-in. square into the reverser jet stream, observing their behaviour. Cubes were thrown in at all levels up to the height of the intake and showed no tendency to rise and no likelihood of entering the intake itself. In fact, when the aircraft was stationary or moving forward only slowly the gas discharged forward tended to act as a vast broom.

At high forward speeds it was found that the jet efflux was bent back so that it never reached the air intakes, while at very low forward speeds, and when the aircraft was stationary, it discharged forward clear of the intakes.

A speed of 70 knots appeared to produce the maximum intake temperatures, with rises of up to 77° C. being recorded. This condition, however, was only transient and the compressor blades never experienced a sustained soak at these high temperatures. In practice a duration of 15 sec. reverse thrust was found usually to be enough on landing; there was thus no cause for anxiety over blade temperatures and it was not necessary to stipulate a minimum speed for the operation of reverse thrust.

The effectiveness of reverse thrust diminishes as aircraft speed falls off, although it can be used down to a complete stop if absolutely necessary.

Operation and Control

The reverse shutters, which control the direction of the gas flow, are operated by pneumatic rams, two of which are fitted to each reverser, the necessary air being bled from the outer-engine compressor. This method avoids the fire hazard inherent in the use of hydraulic fluid and does not suffer the unreliability of electrical operation under hot conditions.

Air supplied from independent tappings at the last stage of the outer-engine compressors is taken forward and fed through a pressure reducing system into a selector control valve in the fuselage. Air piping is in stainless steel throughout.

On the pilot's control pedestal is a single intent lever, operating in the natural sense (i.e., lever forward gives forward thrust).

The throttle levers for the two outer engines are arranged so that they can be lifted at the flight-idle position. The action of lifting operates the reverser selector valve and the reverser rams unlock and move the shutters to the reverse position.

When the full reverse travel of the shutters has been completed an electrical contact is made; this energizes and withdraws a baulking solenoid in the pilot's control pedestal; the two outer-engine levers can then be moved aft to accelerate the engines "in reverse." The more the levers are moved aft the higher the engine's r.p.m.

At the moment the maximum r.p.m. permitted in reverse is 7,550 (in forward thrust the maximum take-off r.p.m. is 8,000). This restriction is present to ensure reliability and long life in the initial operating stages and may well be lifted as experience is gained.

To go into reverse the following actions are necessary:—

1. Pull intent lever aft.
2. Close throttles to flight-idle position.
3. Lift throttles of outer engines.
4. When baulking solenoid is withdrawn, move throttles aft to accelerate engines.

Thrust reversal is most effective at the higher speeds and it therefore, pays to introduce it as soon as possible after touch-down. For this reason the intent lever should be selected aft during the approach so that thrust reversal can be applied without delay.

Once the aircraft has touched down and is committed to the landing the throttles are lifted and the engine accelerated to the maximum permitted r.p.m. as fast as the withdrawal of the baulking solenoid allows.

To revert to normal thrust the procedure is reversed, the throttles being moved forward to the flight-idle position and pushed down, thereby moving the selector valve and operating the pneumatic rams. The latter in turn then open the shutters to the normal forward-thrust position.

Two independent actions are required before it is mechanically possible to go into reverse thrust. First the intent lever must be moved; secondly, the outboard throttles must be lifted. The second action cannot be completed without first moving the intent lever, nor is it possible to move one throttle by itself.

Amber warning lights are fitted to indicate any departure of the shutters from the forward-thrust position. Green lights confirm that the shutters have gone fully into reverse.

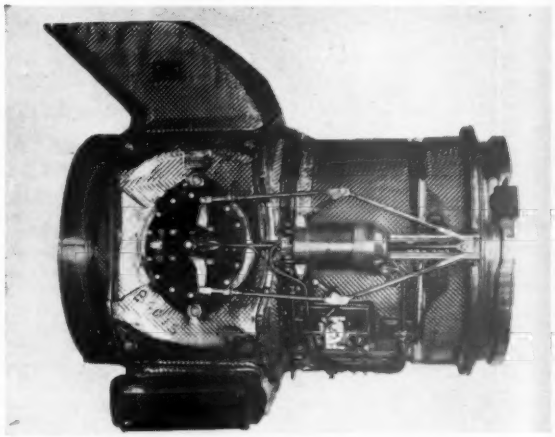
Because solenoids have been known to stick, a baulk override has been fitted. This means that should the green light come on and the baulk has not been withdrawn it can safely be assumed to have stuck and may thus be overridden.

Performance

The jet efflux is discharged from the reverser at 45° forward. The maximum theoretical thrust is therefore 70% of forward thrust. In fact at the same r.p.m. about 50% is realized as reverse thrust under static conditions. This loss of efficiency is caused by having to turn the gas through 135° and also because the effective nozzle area in reverse is a little larger, thus slightly reducing thrust and gas temperatures in the interests of life and reliability.

Rolls-Royce impose a 1-min. limit for operation in reverse to ensure long life and reliability. This is much more than the time required in practice.

A distance of about 575-ft. landing run is saved by using thrust reversal to its fullest extent—by cutting it off at zero forward speed. Translating this into permissible landing weights for a given aerodrome, this would allow—having regard to the latest Air Registration Board requirements—in excess of 10,000 lb. increase of payload under the most adverse runway-length conditions.



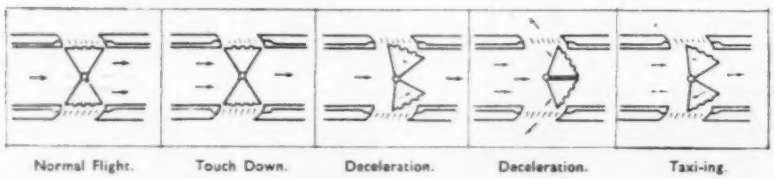
DERBY DEFLECTOR.—Rolls-Royce have developed this thrust-reverser unit for the Avon R.A.29 commercial turbojet. Clamshell doors, normally flush with the jet pipe walls, are brought together in the exhaust flow to deflect it through louvres above and below the wing.

Thrust-reversal fuel penalties are small, recent tests confirming that increased consumption at cruising thrust is not expected to exceed 1.2%.

The weight of the equipment is:—

Weight per engine of complete thrust-reversal unit ..	356 lb.
Installed weight of one complete unit	501 lb.
Total installed weight per aircraft	1,002 lb.

At this stage it would be unwise to forecast any firm figure of thrust-reversal life, but it is hoped to offer a life at least equal to that of engine overhaul life, at present 1,000 hr.



COMET STOPPERS.—These diagrams show the operation of thrust-reversers on the outboard Rolls-Royce Avon R.A.29 turbojets of the de Havilland Comet 4.

Commercial Aviation Affairs

(*Continued from page* 645)

NOT ROME.—At the last moment Pan American cancelled plans to fly its 707s on to Rome from Paris on the daily transatlantic services which started last Sunday, October 26. The Italian Government has continued in the view—maintained by Alitalia at the IATA Traffic conferences—that a surcharge should be applied to turbojet flights. Pan American will operate connecting piston-engined flights between Rome and Paris.

B.O.A.C. PLANS.—On October 27 B.O.A.C. inaugurated the first direct air service between Britain and Venezuela (Carácas) using Britannia 312s. The service is operated via Bermuda, Port of Spain and Barbados, and is flown twice each week. The B.O.A.C. Comet service to the Far East is now expected to start in April instead of May.

BRUSSELS EXTENSION. — The Minister of Communications has now approved a plan for the extension of the main runway at Brussels National Airport to 11,500 ft. The lay-out of the airport was illustrated in THE AEROPLANE for September 26, when the new runway length was incorrectly given as 10,500 ft.

QANTAS TO FIJI.—Early in December Qantas will inaugurate a weekly service between Melbourne and Fiji via New Zealand, to supplement the existing TEAL service.

AMERICAN AIRLINES' JET PLANS.—Following the first flight of their first Boeing 707 on October 5, American Airlines announced that it would introduce the first domestic jet service in the U.S.A. on January 11 with daily flights between New York and Los Angeles. San Francisco and Chicago will be served in addition from January 25 and Dallas, Boston and Baltimore will be added to the jet network later in the year.

EAGLE SUSPENSION.—Eagle Airways will suspend on November 1 their Manchester-Hamburg-Copenhagen service as a result of a seasonal decline in traffic.

ELECTRA DELIVERY.—Eastern Airlines has taken delivery at Burbank of its first Lockheed Electra. It will be introduced on scheduled passenger service on December 1 and the airline expects to have 12 of its 40 Electras by the end of this year.

FRENCH FAILURE.—Air Inter, a company set up earlier this year by Air France, the French railroads and private air operators to fly domestic services within France, has suspended operations for want of support.

S.A.S. TO ALASKA.—On October 10 S.A.S. inaugurated a direct twice-weekly service between Copenhagen and Anchorage. Hitherto, Anchorage had been used as a technical stop on the S.A.S. route between Copenhagen and Tokyo.

U.K. AIR TRAFFIC.—Provisional figures indicate that traffic on U.K. airlines' scheduled and inclusive tour services during August was 12% greater than in August last year. Capacity offered, however, increased by 17% and the overall load factor fell from 66% to 64%. Similar reductions were recorded in June and July.

NEXT WEEK

ON November 7 THE AEROPLANE will, for the 10th time, produce its annual "Airlines of the World" number, a specially enlarged edition containing, among other features, tabulated statistics for the World's airlines in 1957 and a comprehensive guide of summarized facts relating to scheduled operators all over the World.

This issue, which will also contain our regular features, will cost the usual 1s. 6d., from all booksellers and newsagents, or, direct from Temple Press Limited, Bowling Green Lane, London, E.C.1, 1s. 10d.

CAPITAL STRIKE.—All Capital Airlines' services were halted at midnight on October 17 when 2,600 ground engineers went on strike. A similar strike is threatened in Northwest Airlines following a breakdown in negotiations.

MORE CARS THAN EVER.—After a recount, Silver City Airways has concluded that it carried 50,006 cars during the financial year ended September 30, 1958. This is 15 more than previously reported and is 60% more than the total for 1956-57.

G.A.P.A.N. MOVE.—The Guild of Air Pilots and Air Navigators has moved to new headquarters at 14 South Street, Park Lane, London, W.1. The telephone number, Grosvenor 1212, remains the same.

News About People

SARO POST.—Mr. H. Phillips has joined Saunders-Roe, Ltd., as a helicopter test pilot.

NAVAL BALL.—The Fleet Air Arm Officers' Association (an organization which has grown out of the former R.N.V.R. Air Association), is holding its annual ball on November 14 at Londonderry House, 19 Park Lane, London, W.1. Among the guests to be present are the First Lord of the Admiralty, the Rt. Hon. the Earl of Selkirk, O.B.E., A.F.C., and Countess Selkirk, and the Fifth Sea Lord and Deputy Chief of Naval Staff, Vice-Admiral Sir Manley Power, C.B., C.B.E., D.S.O., and Lady Power.

A PIONEER PASSES.—With regret we record that Mr. George H. Handasyde, among the first of that band of British experimenters engaged in aircraft production, died at Iver on October 21. Along with Helmuth P. Martin he was the first to take accommodation at Brooklands in 1910, and together they produced the Martinsyde aircraft. Handasyde was later responsible for the design of the B.A. Eagle of 1933. An appreciation of his life will be published later.

AUSTRALIAN POSTING.—Air Cdre. F. S. Stapleton, D.S.O., D.F.C., is to succeed Rear Admiral R. S. Wellby, C.B., D.S.O., as head of the United Kingdom Joint Services Liaison Staff in Canberra in February, 1959, with the acting rank of Air Vice-Marshal. From June, 1941, to February, 1942, he led the Hornchurch Fighter Wing and since October, 1947, has been S.A.S.O., No. 13 Group.

AWARD FOR LORD DOUGLAS.—Lord Douglas of Kirtleside, chairman of B.E.A., was presented with an Award of Merit of the Institute of Transport on October 13, for his Brancker Memorial Lecture, "The Economics of Speed."

B.E.A. APPOINTMENTS.—Mr. G. J. Shannon, who has been B.E.A. manager in Switzerland since 1956, has been appointed to the same post in France. He replaces Mr. A. A. Pigg, who becomes regional manager at B.E.A. head office. Mr. W. O. Lloyd has been appointed to the post in Switzerland and he is succeeded as B.E.A. manager, Malta and North Africa, by Mr. T. H. Pollock, who since 1948 has been manager in Belgium.

COLLEGE AWARDS.—On October 27 Gp. Capt. D. R. S. Bader presented prizes to students of the College of Aeronautical and Automobile Engineering, of Chelsea and Redhill. As no presentations had been made for three years the list was an extensive one and included the Mollison Trophy (for the student showing the highest standard of general efficiency in aeronautical engineering), 1955, C. Stavrinakis; 1956, P. G. King, and 1957, W. J. Everett; and the Olley Trophy (for the student gaining the highest standard of practical ability in aeronautical engineering), 1955, R. V. Brook; 1956, A. V. R. Rudzki, and 1957, J. C. K. Harding.

U.S. RECIPIENT.—As noted on this page, awards have been presented to students of the College of Aeronautical and Automobile Engineering. Here, right, is Mr. A. Rudzki, winner of the Olley Trophy for 1956, and the principal of the College, Mr. J. A. C. Williams.

VTOL GROUP.—Senior officials of Rolls-Royce, Ltd., recently visited the SC.1 test gantry at Short Bros.' Belfast works. With Mr. D. Keith-Lucas, Short's technical director (centre) are, left to right, Dr. A. A. Griffith (chief scientist), Mr. A. A. Lombard (chief engineer, Aero Division), Air Chief Marshal the Hon. Sir Ralph Cochrane, and Mr. G. L. Wilde.

NEW APPOINTMENT.—In the new changes in the Government, Lord Gosford, formerly Under-Secretary of State at the Foreign Office, has become Lord-in-Waiting. He has been asked by the Prime Minister to help the Minister of Transport and Civil Aviation, as necessary, and he will be the Government's spokesman in the Lords on these subjects. From 1938 to 1940 he was Assistant Air Attaché in Paris, and for two years was C.O. of No. 613 (City of Manchester) Sqn., R.Aux.A.F.; from 1946 to 1948 he was Chief Instructor of the C.U.A.S.

MISSILE MANAGER.—The Boeing Airplane Co., which is to assemble and test the XSM-80 Minuteman SSM, has appointed Mr. T. A. Wilson as Minuteman programme manager. Earlier this year he was appointed project engineering manager of the B-52.

MACH BUSTER.—Air Marshal Sir Frederick Scherger, Chief of the Australian Air Staff, has become the first Australian to fly at Mach 2. During a recent visit to the Lockheed plant at Burbank, California, he flew at this speed in an F-104B Starfighter.

Military Aviation Affairs

LONG-RANGE TRANSPORT.—Short Bros. and Harland has begun test flying of military Britannias. Seen here is the first of three Britannia 252s for the M.o.S. Short is also building 15 Britannia 253s for R.A.F. Transport Command as well as components for five more which are to be assembled at Filton by Bristol.

ATLANTIC FLIGHT.—On October 20 a Bomber Command Victor flew the 2,480 miles from Goose Bay, Labrador, to R.A.F. Marham in 4 hr. 1 min., an average speed of 618 m.p.h.

ONE OF A KIND.—The Spitfire Mk. 16 used by Air Chief Marshal Sir James M. Robb, G.C.B., K.B.E., D.S.O., D.F.C., A.F.C., as his personal aircraft when C.-in-C. Air Forces, Western Europe (British element), now stands outside the Montagu Motor Museum at Beaulieu, Hants. It was last flown in November, 1953, and is now owned by the Swandean Garage, Ltd.

FOLLAND FATALITY.—At an inquest at Boscombe Down last week on Sqn. Ldr. E. J. Roberts, an R.A.F. test pilot, who was killed when a Folland Gnat crashed at Stapleford on October 15, it was said that he was found in his ejection seat with the parachute unopened. The drogue, however, was partially open.

NO. 5 SQUADRON.—The first post-War reunion of former officers and aircrew of No. 5 Sqn., R.A.F., is to be held at the R.A.F. Reserves Club, 14 South Street, London, W.1, on November 29. It is being arranged by Sqn. Ldr. T. P. Fargher, R.A.F. Staff College, Bracknell, Berks, from whom further details may be obtained.

JAPANESE DRONES.—Ten KD2RS target drones, plus spares, have been ordered from the Radioplane Division of Northrop Aircraft, Inc., for the Japanese Maritime Self-Defence Agency. First deliveries will be made in February, 1959.

GERMAN OCCASION.—The first German Federal Navy Air Arm Group which was trained in this country at Fleet Air Arm stations was due to be inspected at Jagel airfield, near Schelswig, on October 29 by Vice-Admiral F. Ruge, Chief of Naval Staff at the Federal Ministry of Defence. Also to be present at the ceremony were the German Minister of Defence, Herr F. J. Strauss, and flag and senior officers of the Royal Navy who were responsible for the German squadrons when they were in Britain. After the inspection the Sea Hawk and Gannet squadrons of the Group were to give a flying display.

MARTIN-BAKER MOD.—As we mentioned in our issue of September 12, the Martin-Baker company, at the request of the R. Norwegian A.F., has installed its Mk. 5 ejection seats in the three types of U.S. fighter in service in Norway, the F-86F, F-86K and RF-84F. Right is a close-up of the F-86K installation of the S.5 seat, and below, the RF-84F and F-86K are seen at Chalgrove before returning to Norway.

A Photographic Autobiography

IT is an old axiom in the periodical business that a good picture is worth a thousand words of copy. A book is published this week in which one of the great pioneers of the business of photographing aeroplanes in and out of their element demonstrates that he can provide himself with some pretty fierce competition by writing as well as he photographs.

This author-photographer, Charles Sims, was born in 1901, two years before the Wright brothers gave their historic demonstration of man's ability to traverse the atmosphere with the aid of the internal combustion engine. In his 57 years he has seen a good deal of the progress of the aeroplane; and indeed, though he does not say so, of the progress (and lack of it) of the airship.

He began his aeronautical experience by joining the Royal Air Force in 1921 and so started an association with the Service which has lasted all his life and was renewed even more closely when, as a reservist, he went to France with the R.A.F. in 1939. And from almost the beginning he had a camera in his hand or more importantly in the aeroplane in which he was flying. Hence the historic scenes in this generously illustrated book of days in Iraq and in Egypt.

When he left the Service in 1927 he went to work at 175, Piccadilly, London, where the founder editor of THE AEROPLANE held court, corresponded and ultimately, when the rest of the world had gone home from work, got down to the joyful if unhurried business of putting his paper together. What this book does not tell us is that adjacently to those interlinked offices (which in 1929 consisted of three rooms only for the entire editorial and advertising staff) and in the same narrow corridor, Charles Sims had his darkroom. After flying all day and often half the night he would come back and do all his own developing and printing.

One great day he got help. Another enthusiast, who like himself had been turned down at his first attempt to get into the Royal Air Force as a pilot, joined the staff of THE AEROPLANE in order to work his way. He was not a skilful apprentice nor talented in the photographic arts. But he had determination and a manner grave beyond his years. In due course he achieved his ambition and became a pilot of fighters in the Royal Air Force. He died gallantly and to his funeral came the highest ranking officer in Africa.

We do hear of a hilarious deception practised on the great C.G. in these same offices by that legendary figure Sidney St. Barbe. But, as I said at the beginning, Sims the writer is photographer Sims' chief competitor and the pictures as well as the stories must be reviewed. These, first class in themselves, are reproduced to an adequate scale. Turning over these well-filled pages of pictures was so evocative a business that it was long after midnight when I finally put the book down.

For the rising generation this is the history book par excellence; aeroplanes, people and events captured by the photographer with all their period glamour. Study of these pages will do a lot to explain to young foik exactly why it was their fathers found flying such fun. Looking at the pictures of pilots and gunners and observers and private pilots explains the appeal of flying aeroplanes in which one sat out in the air.

Charles Sims recalls the Hendon Displays, those greatest of all social aeronautical events. And without doubt the finest series of massed aircraft displays ever staged. One anecdote concerns the devastating experience of the camera-man who had to be cut out of his safety harness. It was the impossibility of freeing Sqn. Ldr. Collett from a similar harness that caused the only fatality that I can recall at all those great displays.

There are 10 chapters in the book and each covers a specific field. Many people will echo the author's words when, wondering to what we can look forward to take the place of the great air races of the past, he admits that he would rather see a return of the Europa Rundflug (the international light aircraft race round Europe) than any satellite handicap or return rocket race to the moon. That may be. I bet that when the first British satellite is launched, Charles Sims is there to photograph it. All of us who know him hope that he will be around to photograph the first Briton to make the return flight to the moon.—T.J.

CAMERA IN THE SKY. By Charles Sims. 217 pp., 6¼ in. by 9¼ in. Illustrated. Temple Press Limited. Price 25s.

COMMERCIAL PILOT'S HANDBOOK. Volume 1, Private and Commercial Licences. By Capt. R. E. Gillman, D.F.C., D.F.M. 230 pp., 4¼ by 7¼. Sir Isaac Pitman and Sons, Ltd. Price 25s.

THE author of this book, the first of two volumes for the serious education of the student pilot, needs no introduction to readers of THE AEROPLANE, to which he has, in the past, contributed many articles on aircraft handling and other subjects. More important, for prospective readers of this handbook, Capt. Gillman is a training captain with British European Airways and an authorized examiner—so he will know what he is writing about.

Volume 1 of the pair provides, in a very readable form, the basic information needed by a student who intends to go for his basic commercial licence. It should be equally valuable for the P.P.L. pupil. Although the book takes the latter a little farther along the road of knowledge than actually necessary, a club pilot will be all the better for the information, since it will give an understanding of at least some of the problems which lead to the present restrictions of freedom in the air.

The chapters on meteorology are particularly clear and useful —and are refreshing reading to anyone who had to learn his meteorology the hard way, using the older official text-books. The book opens with a chapter on that least exciting and most forbidding of subjects—air law—but this provides an entirely logical, if earnest, beginning, since the student pilot should know something of this law before he climbs into the cockpit for the first time. The chapter on the principles of the aero-engine seems to be a little oddly placed as a finale; it might have been better to have arranged this to follow the chapter on the theory of flight.—H.A.T.

JOHNSON'S JOURNEY. By W. D. Pereira. 208 pp., 7½ in. by 5 in. Robert Hale, Ltd. Price 10s. 6d.

QUITE a number of boy apprentices from Halton and the one-time "Boys' Wing" at Cranwell have now graduated through all the vagaries of the Service to Air rank, but none has yet ended his career as a sort of "dog Laika" being sent up 500 miles into space. It does not seem quite commensurate with stripe power.

Peter Johnson was a boy apprentice at "Cranton" and, judging from his picture on the jacket cover—presuming it is him—it is a little surprising that he survived 35 years to become an Air Vice-Marshal, he looks so harassed. However, that may not be the author's fault, but unfortunately there are other things besides which militate against this being quite the sort of book he presumably meant it to be.

It is perhaps fortunate that we do not meet Peter in the air very much. His life is somewhat jaded by an unsuccessful marriage and he spends a few months in France after being shot down and taken in hand by the Underground. He goes to the States on a liaison job and he commands a Group in the British Zone of Austria after the War. Then he gets involved in the shooting down of one of his aircraft by Russians and comes out of it with something of a chip on his shoulder.

It is all rather complicated and somehow one would have liked our Peter more if his life had been a trifle less "dedicated." Perhaps he never learnt to play games at "Cranton."

Well, it must be quite a feat to write the life of a hypothetical A.V.M. and please everybody, and if your reviewer has been rather less than fair to a pretty good try it is because he has known a good many in his time and somehow Peter fails to emerge as one of them.—R.C.P.

Publications Received

ATLANTIC ADVENTURE. By Basil Clarke. 236 pp., 5¼ in. by 8¼ in. Illustrated. Alan Wingate, Ltd. Price 21s.

CAUSES AND PREVENTION OF CORROSION IN AIRCRAFT. By T. C. E. Tringham. 124 pp., 5¼ in. by 8¼ in. Illustrated. Pitman. Price 25s.

THE COMMAND OF THE AIR. By Gen. Giulio Douhet. 199 pp., 6¼ in. by 9¼ in. Rivista Aeronautica.

DOWN IN THE DRINK. By Ralph Barker. 206 pp., 4¼ in. by 7 in. Illustrated. Pan Books, Ltd. Price 2s. 6d.

FLYING MATILDA. By Norman Ellison. 348 pp., 5¼ in. by 8¼ in. Illustrated. Angus and Robertson. Price 25s.

HITLER'S PILOT. By Lt.-Gen. Hans Baur. (Translated by Edward Fitzgerald.) 241 pp., 5¼ in. by 8 in. Illustrated. Frederick Muller, Ltd. Price 18s.

NATURAL AERODYNAMICS. By R. S. Scorer. 312 pp., 5¼ in. by 8¼ in. Illustrated. Pergamon Press, Ltd. Price 60s.

SATELLITES, ROCKETS AND OUTER SPACE. By Willy Ley. 128 pp., 4 in. by 7 in. Illustrated. A Signet Key Book. Price 3s. 6d.

SECRET BOMBER. By Wg. Cdr. H. P. ("Sandy") Powell, 215 pp., 5 in. by 7¼ in. Alan Wingate, Ltd. Price 13s. 6d.

THEY FLEW THE ATLANTIC. By Robert de la Croix. 225 pp., 5¼ in. by 8 in. Illustrated. Frederick Muller, Ltd. Price 18s.

WAR IN THE AIR. By Gerald Bowman. 185 pp., 4¼ in. by 7 in. Illustrated. Pan Books, Ltd. Price 2s. 6d.

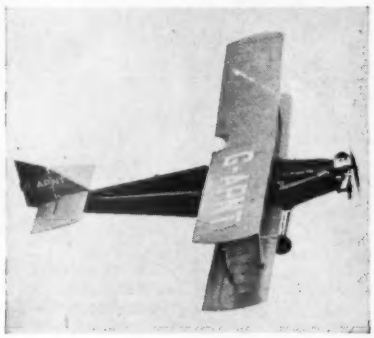
Private Flying

H.J.C.'s CLUB COMMENTARY

● MORE DETAILS are now available about the annual dinner of the **Association of British Aero Clubs and Centres,** which is to be held at the Waldorf Hotel, London, W.C.2, on November 7.

The chair will be taken by Mr. Geoffrey de Freitas, M.P., a vice-president of the Association. The principal guests will be the Air Minister, the Rt. Hon. George Ward, M.P., and the Joint Parliamentary Secretary to the M.T.C.A., Mr. Airey Neave. R.A.F. officers and officials of Ministries have also been invited.

The dinner is a "men only" affair. Tickets cost 35s. each, and applications for them should be made to the Association (7c Lower Belgrave Street, London, S.W.1), as early as possible. The time is 19.00 hrs. for 19.30 hrs.; dress, lounge suit.



The Currie Wot was flown at Portsmouth on September 18.

● IN this column on May 16 last we mentioned the proposed production of the Currie Wot light single-seat biplane by the **Hampshire Aeroplane Club**; the first aircraft, G-APNT, has now been flown, powered by a 36-h.p. J.A.P. engine. It was first taken up by Mr. V. H. Bellamy, of the club, and has since been flown by instructor John Hennessy, and by Air Cdre. G. J. C. Paul, the new and very active secretary-general of the Air League of the British Empire.

The Wot first appeared at Lympne in 1938. Only two were built, and both were destroyed in an air raid. Its designer, Mr. J. R. Currie, now chief engineer of the Hampshire club, and Mr. John Isaacs, have been primarily responsible for its revival.

The club fleet otherwise consists of a Tiger Moth, two Hornet Moths, an Auster, a Chipmunk, a Rapide and the last surviving D.H.86B. The A.R.B. has now agreed to issue a C. of A. for the Spitfire two-seater which the club has had for some years.

● AT THE fourth internationale Alpine rally at Innsbruck, held from September 26 to 28, seven British aircraft took part in the various competitions.

British pilots and their aircraft were: Mr. J. J. Dykes, Proctor, G-AIET; Mr. F. G. Fox, Rapide, G-ADYL; Mr. P. Keating (Airways Aero Club) Aiglet, G-AMTB; Mr. Parker, Autocar, G-AOIY; Mr. J. B. Peak, Percival Q.6, G-AEYE; Mr. Proctor, Gemini, G-AKHK, and Mr. Willinger, Taylorcraft Plus D, G-AHCR.

● TO MARK the end of 20 years' service of the Miles Magister, or Hawk-Trainer 3 as it is known in civil guise, within the group, the **Elstree Flying Club** is to hold a small informal ceremony shortly, to coincide with the last flight of the club's Hawk-Trainer, G-AIUA. As announced some time ago, the club has been steadily disposing of this type, and from the end of November all instruction will be given on the Chipmunks. The club is sorry to see the last of the Maggies, but, with an average annual utilization of 900 hr. per Chipmunk, is sure that it is doing the right thing.

POWER JOB.—The Schweizer Aircraft Corpn., of Elmira, New York, has just produced its first powered design, the Model 1-30. It is a single-seater, and a two-seat version may be produced. The 1-30 is probably the only piston-powered aircraft fitted with spoilers.

Howard Levy photograph.

Gliding Notes

by Dr. A. E. Slater

NOBODY would willingly fly a glider through a waterspout, even at the top end, though once or twice an aeroplane has been flown through one. Besides, waterspouts form over the sea. They start with a whirling projection which grows from the base of a dark cloud mass and extend downwards, and soon afterwards a sort of whirlwind forms over the water and grows upwards to meet it.

A more violent variety of the same thing, the tornado, can form over land, but at the other extreme one sees it sometimes in a mild form as a short projection from a cloud base, waving like an elephant's trunk and breaking up after a few minutes. It was such a phenomenon that John Costin encountered in the neighbourhood of the London Gliding Club at Dunstable on October 12, and, not content merely to circle round it, he completed his investigation, in true scientific spirit, by charging right through it.

Though only a mile away, I missed seeing it; however, it was a cumulo-nimbus day, with the cumulus masses looking remarkably unstable in the early stages of their growth. Dunstable had a south-easterly wind due to a shallow secondary depression centred in the Channel, and "shallow" often means "thundery."

Costin was flying an Olympia below a large cloud mass whose base was at about 2,500 ft. He saw the thing come out of the base of the cloud and grow downwards at an angle of 45° (other observers said it was nearly vertical at first and gradually assumed this angle). He climbed up to it in 8-ft./sec. lift and then, having noticed that it was rotating at about 30 r.p.m. in an anti-clockwise direction (as seen from above), he proceeded to circle tightly round it the opposite way.

On one side of this twisting object there was lift; on the other side zero lift at first and sink later. It was widest where it emerged from cloud base, like an inverted cone, and, having decided to charge through it, Costin did so near its top end. One would have expected it to roll him over, but all he suffered was a quick succession of alternating up and down buffets—rather violent ones.

The whirl extended at least 500 ft. below cloud base and possibly 1,000 ft. at a late stage. A Skylark was circling below it. Finally it was seen to break up from above downwards.

Although such whirls usually appear under cumulo-nimbus, if at all, I have occasionally seen them form below stratocumulus, which has to be rather thick, and arranged in long rolls with dark and well-defined bases. The set-up must be similar to that of a localized cold front, below which it is not uncommon to see ragged bits of cloud rising visibly, and sometimes one of these rags will take the shape of a twisting elephant's trunk. The late "Willie" Watt once got among such rags over Kinder Scout, during the national contests of 1939, and was thrown about so violently that he prepared to jump for it.

* * *

FORMATION of a new Bedfordshire Gliding Club is under way. While searching for a local airfield, they will start by sharing Sywell with the Northamptonshire Gliding Club.

FRANK FOSTER

Cdr. H. C. N. Goodhart writes:—

The tragic death of Frank Foster, in the recent air disaster in Italy, takes from us all a well-loved personality who will be sadly missed by many.

Flying was in his blood, for apart from his deep interest in his work as a senior B.E.A. captain, he devoted much of his spare time to gliding. He owned his own Skylark 2 sailplane in which he had put up many outstanding flights, beating in many cases the achievements of other pilots in the more sophisticated 18-m.-span machines. He holds the United Kingdom single seat 100-km. triangle record with a speed of 46.3 m.p.h. as well as being the joint holder of the British two-seater out and return record at 141 miles. He had earned for himself the highest gliding award, the International Gold "C" badge, with two out of the possible three diamond additions. Together these achievements placed him among the top British gliding pilots and he was in the running for the British team at the next International Championship.

It is a sad and poignant thought that Frank Foster was a member of the airways sub-committee of the British Gliding Association and had devoted himself wholeheartedly to the problem of collision in the air. His articles on the subject had done much to generate an awareness of the problem among Britain's glider pilots.

He leaves a widow and daughter to whom sincere and heartfelt sympathy in their great loss is offered.

It is perhaps fitting to remember that he died as he lived—in the air.

Correspondence

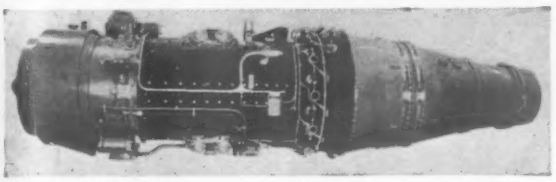
News from East Germany

IN the September 5 number of THE AEROPLANE on page 357 you publish a notice on the test flights of the "first turbojet developed in West Germany."

This does not correspond with the facts. The VEB Industriewerk Ludwigsfelde, where the O14 turbojet was built and tested, is in the German Democratic Republic. The unit is solely a development of the engineers of the German Democratic Republic and the first for civil use in general in Germany.

The O14 is a turbojet unit with 12-stage axial compressor, two-stage turbine and a ring combustion chamber with 12 combustion heads. It produces a static thrust of 3,150 kp. The fuel consumption with this is 0.850 kg./kp./hr.

This turbojet is intended for powering the Type 152 commercial aircraft, which is likewise developed and built in the German Federal Republic, and will give this aircraft a flying speed of 800 k.p.h. It is not built solely for the German Lufthansa, but is also intended for export.



A photograph of the O14 turbojet, as shown at this spring's Leipzig Fair in the Hall of the Democratic Republic Aircraft Industry, is enclosed for use as required.

VEB KOOPERATIONSZENTRALE FÜR DIE FLUGZEUGINDUSTRIE.

[We are pleased to correct the wrong impression we gave about the O14 being produced in Western Germany and to publish the photograph mentioned. The Type 152 airliner was briefly described in our issue of July 4.—ED.]

A Gliding Pioneer

I AM collecting biographical material on the work of José Weiss (1859-1919), and if any of your readers have any personal recollections, newspaper or magazine cuttings, photographs, letters, etc., I should be very pleased to hear from them. Any material loaned will, of course, be returned in good condition and with the least possible delay.

R.F.D.3, Purdy Hill Road, Monroe, Connecticut, U.S.A. EDMUND J. WEISS.

Richthofen's Victories

AS much as I admire Capt. Gerald Maxwell, I must disagree on one point mentioned in his letter in the October 17 issue of THE AEROPLANE. The fact that the S.E.5 was the most outstanding aircraft of World War I.

First let us consider the performances of the two aircraft. As Capt. Maxwell will know, as he was at one time an instructor at the School of Aerial Fighting at Ayr, in Scotland, the S.E.5 proved to have a better gun platform than the Camel, but the latter was far more manœuvrable than the S.E., having a higher speed and rate of climb:—

Camel	*S.E.*
Speed, 121 m.p.h.	117 m.p.h.
Rate of climb, 1,000 ft./min.	650 ft./min.
Ceiling, 19,000 ft.	17,000 ft.

Also the Camel had the distinction of shooting down more enemy aircraft than any other type. (Text books do not agree on this point, some say over 1,000, others say 990 or 980.)

Clacton-on-Sea, Essex. G. A. KING.

What are Missiles Worth?

FOR years and years we have listened to the line shot by boffins and politicians regarding the destructive capabilities of guided missiles, but I would dearly love to see one that could cope with the modern aeroplane *and* aeroplanes to come.

We are shown impressive newsreels and camera shots of a missile tracking down and destroying a potential enemy aircraft. It always hits it and brings it down in flames, but, as I see it, it could hardly miss, as every aircraft we see attacked is either a clapped-out Fortress flying straight and level at an estimated 180 knots or an equally worn-out single-engined fighter (usually a radial) stooging along in a similar senile fashion.

I have watched the descent of the target aeroplane and have timed the rate of fall and have estimated that their height is never more than 8,000 ft.

Judging by the number of failures experienced with these so-called self-homing rockets, they usually go off course, or explode prematurely.

I suggest the characters who have been flannelling everyone for years should "pull their hooks out" and build a missile which is capable of tracking down, striking and destroying an aircraft flying at 100,000 ft., at a speed in excess of Mach 3 with a good measure of violent evasive action thrown in. (It's that what we'll get in the *next* war.)

If and when these learned people can ever do this, which I very much doubt—then, and not before, is the time to do away with fighters—not as they have already done, scrap the fighters and leave us right up the creek!

Upper Belvedere, Kent. G. GILBERT.
(ex-Fighter Command, Spitfire Pilot.)

Groundabout

Christal Ball Dept.—1. Chris Wren's crystal ball is now fully certificated. First, do you remember the postage stamp design featuring a Britannia, which I drew here in August? Well, Bristol's have sent the accompanying picture of a stamp which is suspiciously like my effort. What's that date on it? July? Oh, well.

*

Christal Ball Dept.—2. Secondly, the current issue of Blackburn's *Courier* recalls that two years ago, in a little piece I had in it about their "high-speed" Beverley, I forecast, with a drawing, the resurgence of chief test pilot Harold "Boom-Boom" Wood as a supersonic pilot. Now "Tim" Wood, at 56, has converted to jets, partly to fly their Meteor 7 "Chaser," also to join Derek Whitehead in testing the NA.39. Any questions?

*

Name Game. Speaking of the NA.39, Blackburn's have invited their employees to suggest a name for it. Apart from the chance of winning a prize, this is wasted effort because, as this column pointed out recently, such nomenclatural help is automatically discarded by Authority. Turning my crystal ball into wind, I select the channels marked "Precedent" and "Trend" and up come two groups of possibilities: (i) Lincock, Shark, Skua, Roc; (ii) Thunderbolt, Mustang, Corsair, Hellcat. Any bets?

*

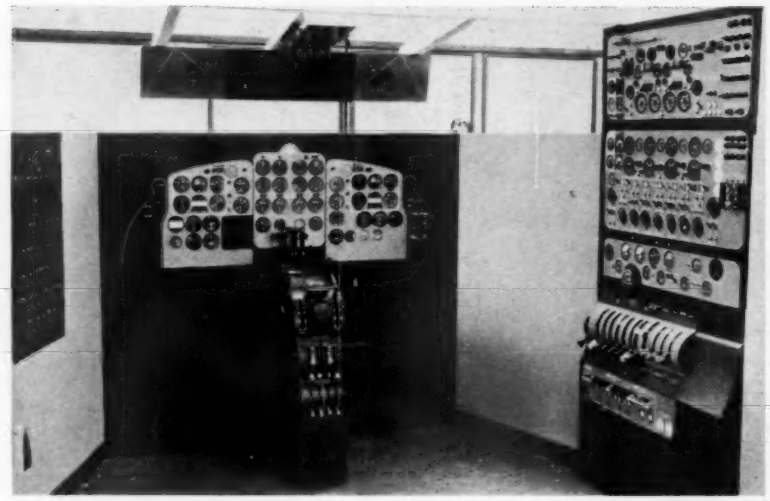
An aircrew man was commenting on the abundance of London Airport's signs, some of them baffling, he reckons. Actually, he meant road signs, but anything *could* happen in that amazing place.

*

IATA Day and Gone Tomorrow. Delegates dispersing after the tribulations of the IATA Cannes Conference say it will probably go down in the records as the "Can't" Conference.

by Wren

NOTES AND EVENTS



SYSTEMS TRAINER.—Enlarged to permit a typical class of six students and an instructor, the D.H. Comet 4 systems trainer is designed to provide a representative range of indications to allow both normal and emergency flight procedures to be practised on the aircraft's operational systems.

NICKEL AT CRANFIELD.—The Mond Nickel Co., Ltd., is holding a four-day exhibition at the College of Aeronautics, Cranfield, starting November 18, the theme of which is the properties and uses of nickel, nickel alloys and related materials. It is designed to inform engineers, designers, metallurgists, and students of the latest developments in this field. The exhibition is open to all industrial and commercial organizations in the area and the College itself will also be open for inspection each afternoon. Invitations are available from the Mond Nickel Co., Ltd., Thames House, Millbank, London, S.W.1.

REINFORCED PLASTICS. — The British Plastics Federation has formed a new group for Reinforced Plastics. Membership of the new group is open to manufacturers who manipulate reinforced plastics and manufacturers of the materials and equipment used in the production of reinforced plastics articles. The purpose of the new group is to foster the growth of the reinforced plastics industry by encouraging and co-ordinating further work on specifications and standards of workmanship, and the investigation of long-term properties.

ENGINEERING MOVE. — John Curran, Ltd., has now transferred the whole of its engineering activities covering the manufacture of aero-engine test equipment, radar and general engineering, to its main works at No. 15 Building, Curran Road, Cardiff. The heavy installation, packaging and carpentry division will remain as before, at the Packing Depôt, Cardiff (Pengam Moors).

SPECIAL PROJECTS.—Detuners, Ltd., has formed a new department, known as special projects, to meet the requirements of ground noise mufflers for pure-jet aero-engines. It will be managed by Mr. R. Dale, who worked with Sir Frank Whittle between 1940 and 1942 and who for the past seven years has been senior overhaul engineer (aero-engines) in the service department of The de Havilland Engine Co., Ltd.

SUSSEX AGENCY. — Hellermann, Ltd., of Crawley, has been appointed sole agent in Great Britain for the range of Suprafix spring-loaded terminal blocks manufactured by Wago-Klemmenwerk G.m.b.H.

BRUSSELS AWARD.—The British Refrasil Co., Ltd., a member of the Darlington Group of companies, has been awarded a bronze medal at the Brussels International Exhibition for its insulation work in aircraft. The company produces Refrasil—a silica fibre—which is employed in jet-engine insulation.

COMPUTER SOCIETY.—A successful and well-attended meeting addressed by the Rt. Hon. The Earl of Halsbury, who took as his subject "Ten Years of Computer Development," opened the British Computer Society's activities in the London area for 1958-59. An extended programme of meetings and activities has been arranged for 1958-59 in London and at a number of its regional branches. Particulars can be obtained from the secretary, British Computer Society, Ltd., Finsbury Court, Finsbury Pavement, London, E.C.2.

YEAR BOOK.—Teddington Aircraft Controls, Ltd., of Cefn Coed, Merthyr Tydfil, Glam., has recently published the 1958 edition of its Year Book. This provides a concise and up-to-date collection of purely technical data concerning the equipment designed and manufactured by the company.

M.R.G. BREAK-DOWN. — S. G. Brown, Ltd., of Shakespeare Street, Watford, has produced a leaflet describing the company's Master Reference Gyro (M.R.G.) in very non-technical language. Available from the company, it gives a simplified breakdown of this complicated equipment.

Company Notices

NEW COMPANY

Skyways Coach Air, Ltd. (612,683).—Private co. Reg. Oct. 9. Cap. £1,000 in £1 shs. Objects: To carry on all kinds of air charter business and that of air transport contractors, etc. Subscribers (each with one sh.): R. C. S. Beecroft, solicitor, and A. Kane, chartered secretary, both of 12 Whitehall, London, S.W.1. First directors to be appointed by subscribers. Solrs.: McKenna and Co., 12 Whitehall, London, S.W.1.

CHANGE OF NAME

Bidgood and Catton Taxi Planes, Ltd. (458,732), 31 Clarendon Road, Leeds, 2.—Name changed to County Air Charter, Ltd., on October 1, 1958.

New Patents

APPLICATIONS ACCEPTED

805,750.—Saunders-Roe, Ltd.—"Aircraft or surface craft."—July 23, 1954 (July 30, 1953).

805,736.—Sud-Aviation Soc. Nationale de Constructions Aéronautiques.—"Equipment for the take-off and landing of aircraft."—Dec. 12, 1955 (Dec. 31, 1954).

Applications open to public inspection on Dec. 10, 1958; opposition period expires on March 10, 1959.

Aviation Calendar

November 1.—British Interplanetary Society lecture, "Astronomical Measurements with Rockets, Satellites and Balloons," by Dr. R. F. Stebbings (University College, London), in the Tudor Room, Caxton Hall, Caxton Street, **London**, S.W.1, at 18.00 hrs.

November 3.—R.Ae.S. Derby Branch, Third Sir Henry Royce Memorial Lecture, "The Present and the Future," by Air Cdre. F. R. Banks, at the Rolls-Royce Welfare Hall, Nightingale Road, **Derby**, at 18.15 hrs.

November 3.—R.Ae.S. Henlow Branch, lecture, "Operation Grapple," by Gp. Capt. R. H. C. Brousson, in Building 62, R.A.F. Technical College, **Henlow**, at 19.30 hrs.

November 3.—R.Ae.S. Gloucester and Cheltenham Branch, rotunda (by invitation of the Society of Instrument Technology), "Instruments for Guided Flight," by G. G. Roberts, M.Sc., A.F.R.Ae.S., at St. Mary's College, St. George's Place, **Cheltenham**, at 19.30 hrs.

November 3-7.—Kronfeld Club, exhibition of paintings of gliding and light aircraft, at 74 Eccleston Square, **London**, S.W.1 (18.00 hrs.—22.00 hrs.).

November 4.—R.Ae.S. lecture, "The Spectre Rocket Engine," by W. N. Neat, A.F.R.Ae.S., in the Library, 4 Hamilton Place, **London, W.1**, at 19.00 hrs.

November 4.—R.Ae.S. Luton Branch lecture, "Guided Flight," by L. H. Bedford (English Electric Co., Ltd.), in the Napier senior staff canteen, **Luton Airport**, at 18.15 hrs.

November 6.—R.Ae.S. Bristol Branch, Junior Committee lecture, "Helicopters," by R. Hafner at Filton House, **Bristol**, at 18.00 hrs.

November 7.—R.Ae.S. and Helic. Assn. of G.B. joint lecture, "Development of the Fairey Rotodyne," by Dr. G. S. Hislop, F.R.Ae.S., at the Institution of Civil Engineers, Great George Street, **London**, S.W.1, at 19.00 hrs.

November 7.—A.B.A.C. annual dinner, at the Waldorf Hotel, **London**, W.C.2, at 19.00 hrs. for 19.30 hrs.

November 7.—Kronfeld Club, dinner/dance, at the Eccleston Hotel, Eccleston Square, **London**, S.W.1., at 19.00 hrs. for 19.30 hrs.

November 10.—R.Ae.S. Glasgow Branch lecture, "Operation of Naval Aircraft and Aircraft Carriers," by Rear Admiral J. P. W. Furse, C.B., O.B.E., R.N., at the Royal College of Science and Technology, Duke Street, **Glasgow**, at 19.15 hrs.

November 11. — R.Ae.S. Lecture, "Boundary Layer Control to Produce High Lift at Low Speeds," by Dr. J. Williams, A.F.R.Ae.S., in the Theatre, Park Lane House, 45 Park Lane, **London**, W.1, at 19.00 hrs.

November 11.—R.Ae.S. Graduates and Students Section lecture, "The Air Transport Auxiliary," by Sir Gerard D'Erlanger (chairman, B.O.A.C.), in the Library, 4 Hamilton Place, **London**, W.1, at 19.30 hrs.

November 11.—R.Ae.S. Boscombe Down Branch lecture, "The Application of an AC Electrical System to Aircraft," by S. S. Hall, in the Lecture Hall, A. and A.E.E., **Boscombe Down**, at 17.45 hrs.